Solar Feasibility Study for the City of Sunnyvale

March 24, 2014

FINAL

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This report has been prepared for the City of Sunnyvale to provide a solar analysis of 14 potential sites for solar installation, with recommendations for future actions that best fit the needs and opportunities for renewable energy at City facilities.

What you will learn from this report:

1. How Optony conducted this analysis for the City of Sunnyvale and the analytical approach used to develop this report.

2. The best City of Sunnyvale sites for photovoltaic solar installations, from both technical and economic perspectives.

3. The recommended photovoltaic (PV) solar system sizes and detailed site characteristics.

4. Next steps for pursuing the recommended option with an approximate timeline.

Introduction

The City of Sunnyvale has engaged Optony Inc. to conduct a solar feasibility for multiple City-owned sites. Solar electric (also called photovoltaic, or PV) installations can reduce the City's reliance on utility-generated energy while reducing operational costs. By producing on-site power from a clean and renewable source (sunlight), the City can reduce its carbon footprint and demonstrate environmental leadership to both City residents and to neighboring jurisdictions.

Figure 1: Solar carports at a municipal water treatment plant

The City of Sunnyvale, like many California municipalities, is faced with environmental and economic challenges. A major cost of operations for municipal facilities is the electricity usage, paid to the utility company—in this case, Pacific Gas & Electric (PG&E). Cities like Sunnyvale are also encouraged by California Assembly Bill 32 to reach specified carbon dioxide emissions reductions, which are expected to be achieved, at least partially, through investments in energy efficiency and on-site renewable energy generation. Solar PV can help Sunnvale reach both financial and environmental goals. Through Net Energy Metering (NEM) with the utility company, municipal electrical accounts with solar installations can save money on energy costs, while reducing greenhouse gas emissions. NEM allows for solar generation exported to the grid to be credited at the same price as the City would pay for energy use at the same time-of-day and year. There are restrictions to how much credit NEM accounts can accrue, but generally, these net-metering arrangements give the highest value for solar production. An additional benefit of solar project construction is increased local economic activity, both for installation labor teams and for surrounding businesses during construction.

Executive Summary

Optony has performed a detailed technical and financial analysis of sites presented by the City. Table 1, on Page 5, presents a brief summary of the results of this study. The criteria for site evaluation include electricity usage at the site, physical space available for PV installation, existing conditions at the site including age of the building and structural and electrical limitations, planned energy or structural renovations, as well as surrounding vegetation and other shading concerns.

Where available, the Optony team collected a minimum of 12 months of prior electric usage data for each site and performed a thorough analysis on all material aspects of potential PV systems using industry standard tools and our market leading approach. Based on the data analysis, we have identified which sites are viable for solar PV system installations, both from a technical and economic perspective. For each site, we have mapped out usable areas for solar PV using a modular approach to provide system and project design flexibility. Along with usable areas, the report analyzes potential output and details site-specific opportunities and constraints.

Next steps for system procurement have been recommended for when the City of Sunnyvale proceeds with these solar projects. It is very important to be aware of the time-sensitive availability of certain state and federal incentives. For example, the U.S. Internal Revenue Service's Investment Tax Credit (ITC) program is slated to drop dramatically in 2016, from 30% to 10%. This program, which allows for significant cash-flow benefits for tax-eligible PV system owners, can lead to lower pricing for third-party ownership installation models such as PPA's, and sometimes leases, as described below.

In terms for financial drivers, Optony has modeled the possibilities of Renewable Energy Self-Generation Bill Credit Transfer, commonly referred to as Virtual Net Energy Metering at the Corporation Yard and SMaRT Station, with economic implications for both the City sites. Additionally, financial modeling is included for three likely financing mechanisms: Direct Purchase, Power Purchase Agreement, and Lease. Optony recommends that the City of Sunnyvale consider several or all of these options during the procurement phase when deciding to pursue solar projects:

1. Direct Purchase – The City would use existing cash reserves to purchase the system outright. In this situation, the City would be responsible for all ownership concerns, including Operations & Maintenance (O&M), regular system cleaning, and monitoring of system production. In many situations, this may yield the greatest long-term returns, but requires cash up-front and operational costs.

2. Power Purchase Agreement (PPA) – The City would enter into a contract with a third party to purchase all energy produced by a PV system installed on property owned by the City. This third party would own the PV system and would be responsible for all ownership costs, including financing, maintenance, insurance, and system production.

3. Loan/Lease – Instead of paying for purchase costs up-front, the City would pay a third party on a monthly basis over 10 to 20 years. In many such arrangements, the City would be responsible for all ownership concerns, just as with a Purchase. Locally-issued bonds or renewable energy bonds, such as CREBs (Clean Renewable Energy Bonds) and QECBs (Qualified Energy Conservation Bonds), have similar cash-flow models and would fall into this category.

This report uses Levelized Cost of Energy (LCOE) to compare the various financial drivers. LCOE is an assessment of the cost of the energy-generating system including all the costs over the lifetime of the system (initial investment, operations and maintenance, cost of fuel, etc), at net present value, and compares it with the forecasted lifetime energy production. This allows for a fair comparison between various generating sources and financial mechanisms.

Detailed in the following sections is a thorough report of Optony's methodology, findings, and recommendations for this solar feasibility study. Optony is pleased to work with the City of Sunnyvale, and we look forward to many opportunities for collaboration in the near future!

Site Evaluations

The Optony team conducted site visits at 14 sites presented by the City of Sunnyvale:

- Corporation Yard
- Hamilton Well / Water Plant
- Mary – Carson Water Plant
- Ortega Well
- Raynor Well
- San Lucar Pump Station
- Serra Well
- Wolfe – Evelyn Water Plant
- Wright Avenue Water Plant
- Sunken Gardens Lift Station (2 meters)
- Baylands Park Lift Station (3 meters)
- SMaRT Station
- Landfill
- Wastewater Treatment Plant Retention Ponds

A site visit involves reviewing the overall layout of the proposed facility and identifying potential location opportunities and challenges. The age, materials, and condition of the rooftop, if available for development, are assessed, as photovoltaic systems typically have a 25-year lifespan and are costly to remove for roof repair or replacement. For rooftop sites, additional space-limiting concerns are evaluated, including HVAC equipment, parapets, skylights, and conduits - all of which cannot be easily relocated. For parking lot carport or shade structure PV systems, the main site selection issues are the availability of space for construction, surrounding shade sources, and distance to the electrical interconnection point. For both installation types, potentially usable areas are identified and a detailed shading analysis is conducted.

Shading analysis is performed on-site within the designated usable areas, with outer boundaries set by observing industry installation guidelines and best practices. A shading analysis involves surveying the surroundings of the usable areas to identify potentially shade-causing obstructions, such as rooftop HVAC equipment, lightning conductors, antennas, trees, lampposts, building overhangs, and neighboring buildings. Shading must be avoided, as PV systems operate most efficiently in direct sunlight, and even minor shading can sometimes have a profound negative impact on system performance.

As the seasons change, the sun path changes as well. In the winter months, the altitude of the sun off the horizon is lower in comparison to its altitude during the summer months – this leads to varying sunlight and shading situations each month. In order to assess the amount of direct sunlight available at each usable area, the annual sun path is plotted at various points using hardware and software developed for use in the solar industry. Further analysis of the data yields the most optimal areas for solar installation at each site.

Whenever possible, the electrical room at each site is inspected for main breaker and switchgear amperage and voltage ratings, as well as availability of space for additional electrical equipment. The location of the utility electrical meter is determined, as well, since the distance between the solar modules and the interconnection point should be minimized to reduce voltage drop and increase system efficiency.

Table 1 below shows a summary of the project economics for solar development at the reviewed sites, along with recommended PV system sizes and expected solar production compared to facility electricity usage. A direct purchase cost range is shown, and the projected gross utility bill savings and projected Net Present Value of cost savings are also included in this table.

Table 1: City of Sunnyvale Solar PV Project Overview

Site Name	Recommended PV System Size (kW-DC)	Estimated Annual PV Output (kWh)	Estimated Annual Building Usage (kWh)	Recommend Site Energy Offset	Gross Avoided Utility Cost - Year 1	Direct Purchase Cost Range[1]	NPV[2, 3] Total Energy Cost Savings - Direct Purchase	NPV[2, 3] Total Energy Cost Savings - Loan/Lease	NPV[2, 4] Total Energy Cost Savings - PPA	Estimated Payback Period - Purchase[5] (yrs)
Corporation Yard	25	37,665	47,780	79%	$9,130	$90,963 - $100,538	$120,811 - $181,677	$113,466 - $174,333	$92,849 - $153,716	9
Hamilton Well / Water Plant	-	-	68,320	-	-	-	-	-	-	-
Mary-Carson Water Plant	-	-	448,960	-	-	-	-	-	-	-
Ortega Well	122	172,312	227,067	76%	$41,437	$464,550 - $513,450	$441,564 - $700,688	$404,057 - $663,181	$367,562 - $626,687	10
Raynor Well	-	-	5,480	-	-	-	-	-	-	-
San Lucar Pump Station	-	-	400,640	-	-	-	-	-	-	-
Serra Well	-	-	15,920	-	-	-	-	-	-	-
Wolfe-Evelyn Water Plant	-	-	329,760	-	-	-	-	-	-	-
Wright Avenue Water Plant	-	-	154,880	-	-	-	-	-	-	-
Sunken Garden - Pump Meter	-	-	73,498	-	-	-	-	-	-	-
Sunken Garden - Golf Range Meter	-	-	36,772	-	-	-	-	-	-	-
Baylands Park - Lift Meter	28	40,620	58,960	69%	$10,800	$76,076 - $84,084	$165,217 - $233,254	$159,074 - $227,112	$112,272 - $180,309	7
Baylands Park - Park Meter	38	55,127	57,840	69%	$10,680	$103,246 - $114,114	$124,798 - $190,119	$116,462 - $181,783	$52,945 - $118,266	9
Baylands Park - Storm Lift Meter	-	-	76,512	-	-	-	-	-	-	-
SMaRT Station	241	347,282	419,369	83%	$100,070	$654,797 - $723,723	$1,600,807 - $2,235,024	$1,547,939 - $2,182,157	$1,153,357 - $1,787,575	7
Total for City Utility Solar Sites	**454**	**653,005**	**2,421,758**	**81%**	**$172,117**	**$1,389,632 - $1,535,909**	**$2,453,196 - $3,540,763**	**$2,340,999 - $3,428,566**	**$1,778,985 - $2,866,552**	
Landfill	5,000	7,880,404	-	-	-	$18,192,500 - $20,107,500	$1,329,567 - $7,262,020	-$139,266 - $5,793,187	-$5,489,996 - $442,457	13
Wastewater Treatment Plant Retention Pond	5,000	8,036,925	-	-	-	$18,192,500 - $20,107,500	$2,851,908 - $9,188,363	$1,383,074 - $7,719,530	-$4,520,706 - $1,815,750	13
Total for Community Solar Sites	**10,000**	**15,917,330**	**-**	**-**	**-**	**$36,385,000 - $40,215,000**	**$4,181,474 - $16,450,384**	**$1,243,808 - $13,512,717**	**-$10,010,702 - $2,258,207**	
Total for All Sites	**10,454**	**16,570,335**	**2,421,758**	**81%**	**$172,117**	**$37,774,632 - $41,750,909**	**$6,634,670 - $19,991,147**	**$3,584,807 - $16,941,283**	**-$8,231,716 - $5,124,760**	

[1] Cost before any incentives and/or rebates; Cost range uses assumption of $2.72-$3.00/Watt-DC (for >50 kW-DC systems) and $3.64-$4.02/Watt-DC (for <50 kW-DC systems) as installed cost

[2] Net present value uses a 25 year financial analysis period; 3% annual discount rate; PG&E 3% - 5% annual escalation; A6 TOU utility rate schedule where appropriate; 0.5% annual PV system degradation

[3] O&M cost of $15/kW with a 3% annual escalation

[4] PPA rate of $0.15/kWh with a 3% escalation rate

[5] Payback Period uses 5% PG&E escalation rate

Recommended system sizes are determined by using a variety of factors which include: electricity usage amounts and patterns, maximum possible energy offset, projected cash flows, and Net Present Value (NPV) of energy savings. All numbers are estimated and intended for planning purposes only. A kilowatt (kW) is a common unit for measuring power, typically for either maximum spontaneous capacity of solar generation or maximum power load of a facility. In this report, kilowatt-DC (kW-DC) refers explicitly to Direct Current capacity of solar installations, before inversion of power to alternating current, or AC. Kilowatt-hours (kWh) is a unit of energy measurement to track power production or consumption over time. As Table 1 shows, with direct purchase of the City Utility recommended systems at mid-range prices, the City can potentially gross nearly $2.4M - $3.5M in electricity bill savings over the 25-year expected operating life of the proposed systems at the most financially beneficial electricity rate schedules available. A full summary of the City of Sunnyvale sites and their economic potential is included in Attachment A. Additionally, Table 2 below shows a simplified version of Table 1 with only the recommended sites details.

Table 2: Simplified Table with only Recommended site details

Site Name	Recommended PV System Size (kW-DC)	Estimated Annual PV Output (kWh)	Estimated Annual Building Usage (kWh)	Recommend Site Energy Offset	Gross Avoided Utility Cost - Year 1	Direct Purchase Cost Range[1]	NPV[2, 3] Total Energy Cost Savings - Direct Purchase	NPV[2, 3] Total Energy Cost Savings - Loan/Lease	NPV[2, 4] Total Energy Cost Savings - PPA	Estimated Payback Period - Purchase[5] (yrs)
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Total for City Utility Solar Sites	**454**	**653,005**	**811,016**	**81%**	**$172,117**	**$1,389,632 - $1,535,909**	**$2,453,196 - $3,540,763**	**$2,340,999 - $3,428,566**	**$1,778,985 - $2,866,552**	

[1] Cost before any incentives and/or rebates; Cost range uses assumption of $2.72-$3.00/Watt-DC (for >50 kW-DC systems) and $3.64-$4.02/Watt-DC (for <50 kW-DC systems) as installed cost

[2] Net present value uses a 25 year financial analysis period; 3% annual discount rate; PG&E 3% - 5% annual escalation; A6 TOU utility rate schedule where appropriate; 0.5% annual PV system degradation

[3] O&M cost of $15/kW with a 3% annual escalation

[4] PPA rate of $0.15/kWh with a 3% escalation rate

[5] Payback Period uses 5% PG&E escalation rate

Corporation Yard

Site Address: 221 Commercial Street, Sunnyvale, CA 94085

Type of PV System:	Rooftop / Carport
Current PG&E Rate Schedule:	HA-10S
Annual Energy Usage:	47,780 kWh
Maximum System Size:	597 kW-DC
Maximum System Output:	855,725 kWh
Recommended System Size:	25 kW-DC
Recommended System Output:	37,665 kWh
Energy Offset:	79% recommended

Issues:	Large vehicles; Minor shade from tower
Opportunities:	Carport and rooftop installation; High energy offset

The Corporation Yard is a large campus composed of an Administration building, constructed primarily in the 1970s, and multiple shade structures. The Administration building rooftop was renovated approximately 3-5 years ago. The shade structures, located northwest corner of the campus, are not usable due to loading limitations. The usable areas at this site are shown in Figure 2 below. The white box indicates the location of the main electrical room at this site.

Figure 2: Corporation Yard Usable Areas

In total, fourteen usable sections were reviewed at this site: seven rooftop sections and seven carport sections. Utilizing all fourteen sections, this site has enough space to host a 597 kW-DC solar PV system which would produce approximately

855,725 kWh annually. Table 3 shows size and production details for each usable section, as well as recommended sizing and estimated production.

Table 3: Corporation Yard Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
Rooftop			
1	190°	894	9
2	190°	733	8
3	190°	1,911	20
4	190°	1,231	13
5	190°	704	7
6	190°	1,094	11
7	100°	1,852	19
Carport			
8	190°	10,148	121
9	100°	6,828	81
10	100°	5,589	67
11	100°	5,955	71
12	100°	5,884	70
13	180°	2,050	24
14	180°	6,281	75
Total		42,735	509
Total System Production (kWh)			855,725
Recommended System Size (kW)			**25**
Recommended System Output (kWh)			**37,665**

The electricity usage over the past 12 months is 47,780 kWh. Under a Net Energy Metering (NEM) agreement with PG&E, the recommended system size of 25 kW-DC would offset 79% of the usage at this site, and would virtually eliminate the electricity bill. With a NEM agreement, the energy produced by the PV system during daylight hours flows into the load at the meter, reducing or eliminating the need to purchase electricity from the utility. Excess energy is passed directly onto the utility grid, building up energy credits for the site. These credits are used up at night when the solar system is not generating electricity but utility costs are lower. While a solar PV system of a larger size can be installed at this site, this is not recommended since a larger system size would cost more and would not yield higher energy savings. However, if the City seeks to utilize Community Solar or Virtual Net Metering programs, this location does offer excess solar capacity that could be used for exporting solar generation credits to off-site utility accounts under one of those programs.

Sections 1-7 are located on the rooftops of the buildings. Sections 1, 2, 4, and 6 are southwest-facing and are pitched at approximately 12°. Sections 3 and 5 are nominally flat, and Section 5 is located approximately five feet below the ridge height of Sections 4 and 6. Section 7 is an eastern-facing roof with a pitch of about 5°. The rooftops are covered with a PVC or TPO membrane coating over wood decking. Roof surfaces were renovated around 2009, and appear to be in fair condition. A structural engineering review is advised prior to finalization of any solar installation contract and in accordance with building permit guidelines. Figure 4 on the following page give partial views of the rooftop areas.

Section 8 is currently in use as a materials storage area. This location may be considered for a solar shade structure. Any new structure in this section would need to be rain-proof on the top level, and would be required to be 14-feet high at the minimum. Sections 9-14 are located over parking spaces for City maintenance and employee vehicles. Large vehicles regularly

park in Sections 9-12, so 14-foot solar carports would be required in those sections. Figure 3 on the following page shows a view of the northern parts of Sections 9-12.

Figure 3: Rooftop Sections 1-3, and Carport Sections 9-12, looking northwest

Figure 4: Rooftop Section 4 in the foreground, looking west

Rooftop space is limited by HVAC equipment and vents. Section 7 may see shade from a tree to the southeast during the morning hours. The southern parts of Sections 9, 10, and 11 are shaded by the approximately 60-foot cell tower to the southwest.

There is a single meter at this site, which is located inside an electrical room indicated by the white box in Figure 2. The voltage rating is single-phase, 120/240-V, and the rating of the switchgear is 600-Amp with a 400-Amp main breaker. There is no room within the electrical room for additional electrical equipment, but substantial space is available in nearby areas.

This site is Recommended for proceeding with a solar procurement, since electrical needs can be met by utilizing only 4% of the proposed areas. Rooftop PV arrays could utilize existing space, providing the benefits of an easier, lower cost installation, while carports in this location could provide useful shade and partial rain cover for visitors, employees, and stored materials. Both types of arrays provide energy to the facility, as well as a visual symbol of Sunnyvale's dedication to greenhouse gas reductions.

Hamilton Well / Water Plant

Site Address: 1200 South Bernardo Avenue, Sunnyvale, CA 94086

Type of PV System:	Rooftop
Current PG&E Rate Schedule:	A-1P
Annual Energy Usage:	68,320 kWh
Maximum System Size:	60 kW-DC
Maximum System Output:	84,570 kWh
Recommended System Size:	- kW-DC
Recommended System Output:	- kWh
Energy Offset:	0% recommended

Issues:	No well penetrations; Structural concerns; Tank cleaning schedule
Opportunities:	Potential high energy offset

The Hamilton Well and Water Plant consists of three water storage tanks around a small pump facility, all located in a residential area of Sunnyvale. The tops of the tanks were renovated within the past 5 years, but a structural review is highly recommended prior to installation. Each of the tanks is approximately 25-feet tall and holds up to half a million gallons of water. The usable areas are shown in Figure 5 below, and the white box indicates the location of the electrical meter.

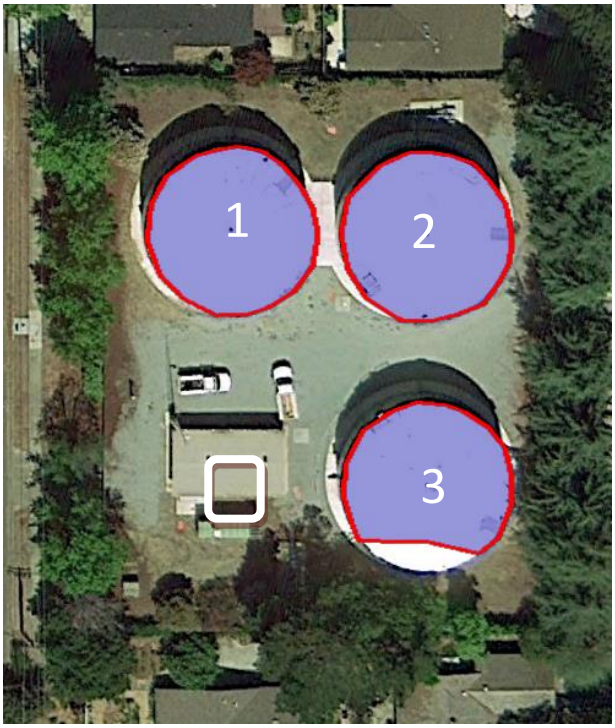


Figure 5: Hamilton Well Usable Areas

The three reviewed sections can accommodate a 60 kW-DC PV system that would produce approximately 84,570 kWh annually. Strictly from an economic perspective, a small 38 kW-DC system is recommended for this site. However, due to physical limitations the recommended system size is not viable. Table 4 below gives details about the outlined sections.

Table 4: Hamilton Well Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
1	180°	2,014	21
2	180°	1,976	21
3	180°	1,698	18
Total		1,501	60
Total System Production (kWh)			84,570
Recommended System Size (kW)			-
Recommended System Output (kWh)			-

The electricity usage over the past 12 months is 68,320 kWh. Under a Net Energy Metering (NEM) agreement with PG&E, the recommended system size of 38 kW-DC would offset 78% of the usage at this site, and would virtually eliminate the electricity bill. With a NEM agreement, the energy produced by the PV system during daylight hours flows into the load at the meter, reducing or eliminating the need to purchase electricity from the utility. Excess energy is passed directly onto the utility grid, building up energy credits for the site. These credits are used up at night when the solar system is not generating electricity but utility costs are lower. While a solar PV system of a larger size can be installed at this site, this is not recommended since a larger system size would cost more and would not yield higher energy savings.

Water tanks at this site are covered by steel top layer, and any installation at this site would need to be non-penetrating. Per the maintenance schedule, the tanks are cleaned every 7 years, which involves sanding, resurfacing, and repainting. The typical lifespan of a PV system is upwards of 20 years, which means that any PV installed on the tanks would need to be removed and re-installed 2-3 times over the useful life of the system. A system installed at this site would need to be offline for an extended period of time during the cleanings. Figure 6 below gives a view of the top of two of the tanks.

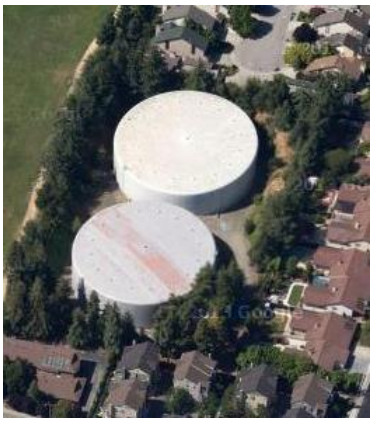
Figure 6: Partial view of Section 1, from Section 2, looking west

Shading is prevalent at this site, with a small communications tower in the northwest corner of the pump facility and redwood trees on the east and west sides. Southern exposure to Section 3 is partially blocked by a neighboring tree.

The meter for interconnection is located on the south side of the pump building, as shown by the white box in Figure 5. Main building voltage is three-phase, 480/277-V, with 600A ratings for both the switchgear and main breaker. Within the electrical room, there is space for additional electrical equipment.

Due to restrictions on available, un-shaded space, structural concerns and 7 year cleaning schedule, this site is Not Recommended for solar installation.

Mary – Carson Water Plant



Site Address: South Mary Ave. and West Washington Ave., Sunnyvale, CA 94086

Type of PV System:	Rooftop
Current PG&E Rate Schedule:	A-6 S TOU
Annual Energy Usage:	448,960 kWh
Maximum System Size:	265 kW-DC
Maximum System Output:	373,518 kWh
Recommended System Size:	- kW-DC
Recommended System Output:	- kWh
Energy Offset:	0% recommended

Issues:	No well penetrations; Structural concerns; Tank cleaning schedule
Opportunities:	Potential high energy offset

The Mary-Carson Water Plant consists of two large water storage tanks and a small pump building. The tanks are approximately 30-feet tall and are located in a residential area next to Vargas Elementary School. The tanks were constructed less than 15 years ago, and an electrical upgrade is planned in the next few years. The two usable areas at the Plant are the tops of the tanks, as shown in Figure 7 below. The white box indicates the location of the electrical room at the site.

Figure 7: Mary-Carson Water Plant Usable Areas

The Mary-Carson Water Plant consumes 448,960 kWh of electricity annually. Within the two identified areas, a 265 kW-DC solar system could be installed. A system of this size is capable of producing 373,518 kWh each year. From an economic

perspective, a smaller system size of 198 kW-DC is recommended, which would produce about 62% of the site's electricity needs. However, due to site limitations a solar installation is not viable at this time. Table 5 gives solar potential details for each of the outlined sections.

Table 5: Mary-Carson Water Plant Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
1	180°	13,718	144
2	180°	11,601	121
Total		25,319	265
Total System Production (kWh)			373,518
Recommended System Size (kW)			-
Recommended System Output (kWh)			-

Under a Net Energy Metering (NEM) agreement with PG&E, the recommended system size of 198 kW-DC would offset 62% of the usage at this site, but would virtually eliminate the electricity bill. With a NEM agreement, the energy produced by the PV system during daylight hours flows into the load at the meter, reducing or eliminating the need to purchase electricity from the utility. Excess energy is passed directly onto the utility grid, building up energy credits for the site. These credits are used up at night when the solar system is not generating electricity but utility costs are lower. While a solar PV system of a larger size can be installed at this site, this is not recommended since a larger system size would cost more and would not yield higher energy savings.

Figure 8 below shows a view of the top of both tanks located at this site. Tank surfaces are covered with a white coating over metal sheeting. Penetrations into the tank for PV installation are not allowed. The tank surfaces are cleaned approximately every seven years, which includes sanding, re-surfacing, and re-painting of the surfaces. The tank caps are pitched at approximately 5° from the center down to the edges. The storage tanks receive some shading from surrounding trees, primarily in the morning and late afternoon hours

Figure 8: Partial view Sections 1 and 2, from Section 2 looking north

The electrical room at this site is located inside the small pump building southeast of the tanks, as indicated by the white box in Figure 7. Site voltage is three-phase, 480/277-V, with 800 amperage rating for both the switchgear and main breaker. There is available space within the electrical room for additional electrical equipment.

Due to the structural concerns and 7 year cleaning schedule, this site is Not Recommended for solar installation. Planning and budgeting for solar at this site must include temporary removal and replacement of rooftop arrays every 7 years.

Ortega Well

Site Address: Ortega Park, Inverness Way, Well #11, Sunnyvale, CA 94087

Type of PV System:	Carport
Current PG&E Rate Schedule:	A-6
Annual Energy Usage:	227,067 kWh
Maximum System Size:	123 kW-DC
Maximum System Output:	174,017 kWh
Recommended System Size:	122 kW-DC
Recommended System Output:	172,312 kWh
Energy Offset:	76% recommended

Issues:	Limited space around well; Trenching distance; Partial shade concerns; Carport availability
Opportunities:	High energy offset; Shade structures

The Ortega Well is located at the extreme southeastern corner of Ortega Park in Sunnyvale. The areas considered for solar installation are the parking lots to the north of the park and shade structures in the northeast section picnic area. The park and parking lots are managed by the Sunnyvale Public Works Department, but the parking is shared with the neighboring Stocklmeir Elementary School. The usable areas of the parking lot at Ortega Park are shown in Figure 9 below. The location of the utility meter electrical closet is indicated by the white box.

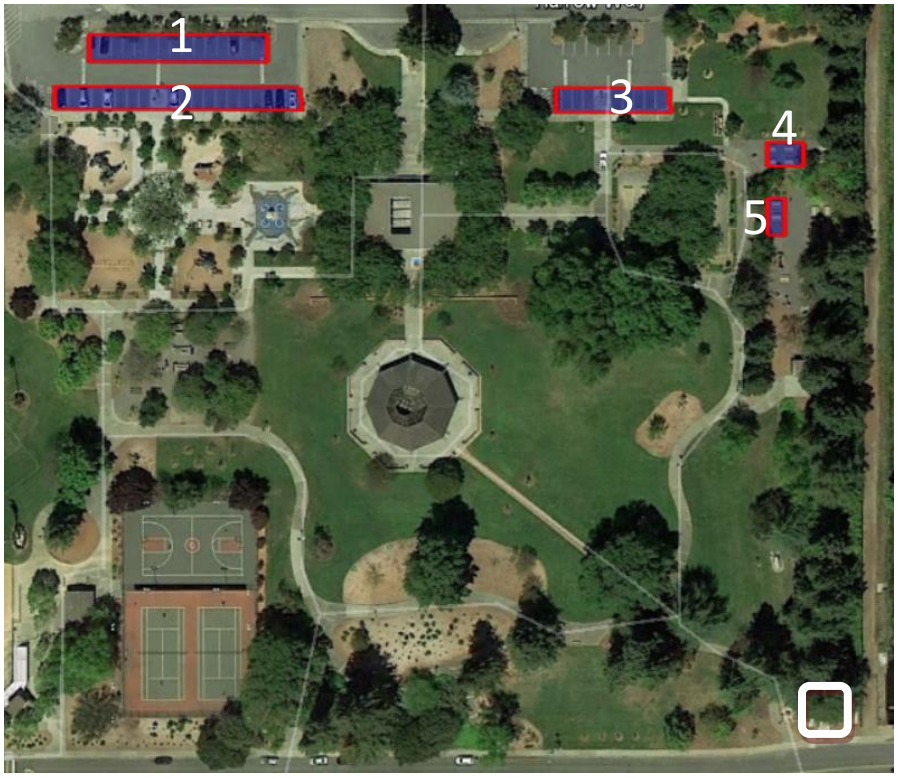


Figure 9: Ortega Well Usable Areas

The five identified usable sections are capable of hosting a 123 kW-DC PV system. A system of this size would produce approximately 174,017 kWh annually. The last 12 month energy usage, 38,000 kWh, was very low, due to low well pump

demand. A better representation of the site's usage is the 36 month average annual usage, which was 227,067 kWh. The recommended system size, taking into consideration the last 36 month usage, is 122 kWh, which would produce 172,312 kWh. This system would offset approximately 76% of the site's energy usage. Table 6 gives details about each of the outlined sections.

Table 6: Ortega Well Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
1	180°	3,126	37
2	180°	4,029	48
3	180°	2,105	25
4	180°	648	8
5	180°	462	6
Total		9,260	123
Total System Production (kWh)			174,017
Recommended System Size (kW)			**122**
Recommended System Output (kWh)			**172,312**

Under a Net Energy Metering (NEM) agreement with PG&E, the recommended system size of 122 kW-DC would offset 76% of the usage at this site, and would virtually eliminate the electricity bill. With a NEM agreement, the energy produced by the PV system during daylight hours flows into the load at the meter, reducing or eliminating the need to purchase electricity from the utility. Excess energy is passed directly onto the utility grid, building up energy credits for the site. These credits are used up at night when the solar system is not generating electricity but utility costs are lower. While a solar PV system of a larger size can be installed at this site, this is not recommended since a larger system size would cost more and would not yield higher energy savings. However, if the City seeks to utilize Community Solar or Virtual Net Metering programs, this location does offer excess solar capacity that could be used for exporting solar generation credits to off-site utility accounts under one of those programs.

Figure 10 shows a view of Section 3. As at any proposed solar carport location in Sunnyvale, existing lighting would need to be removed and replaced with new under-canopy lighting. In Section 1, approximately nine trees would need to be removed to allow construction of a solar carport in that area. Section 2 is bordered by seven young trees to the south that would likely need to be re-located to avoid future shading. Mature trees to the far southeastern and southwestern corners of Section 2 may also need to be removed or trimmed to allow utilization of the entire section. Section 3 is shaded by a single tree to the southwest, and one young tree would likely need to be re-located to avoid future shading.

Additionally Sections 4 and 5 are possible shade structures for the park picnic area. There are about 6 trees south of the sections that would need to be removed or re-located. There are also multiple BBQ pits that would need to be accommodated during system design.

Figure 10: Partial view of Section 3, looking southeast

Figure 11: A view of the well electrical closet

The electrical closet is located in the southwest corner of the property as show by the white box in Figure 9, and as pictured in Figure 11. Site voltage is three-phase, 480/277-V, with 600 amperage rating for both the main breaker and switchgear. Space is available immediately next to the electrical closet but an enclosure will have to be constructed to house the solar electrical equipment.

This site is Recommended for proceeding with a solar procurement, since electrical needs can be met by utilizing all of the proposed areas. Carports and shade structures in this location could provide useful shade and partial rain cover for park visitors while providing energy to the facility.

Raynor Well

Site Address: Dunford & Partridge, Sunnyvale, CA 94087

Type of PV System:	Carport
Current PG&E Rate Schedule:	A-6 S TOU
Annual Energy Usage:	5,480 kWh
Maximum System Size:	64 kW-DC
Maximum System Output:	90,208 kWh
Recommended System Size:	- kW-DC
Recommended System Output:	- kWh
Energy Offset:	0% recommended

Issues:	Trenching distance; Partial shade concerns; Park carport availability
Opportunities:	Potential high energy offset; Shade structures

The Raynor Well is located at the northwestern corner of the Raynor Park. Usable areas for solar installation are located in the southeast corner of the property, as indicated on Figure 12. The main electrical connection is located at the well on the opposite side of the property, as indicated by the white box in the top left corner of the figure below.

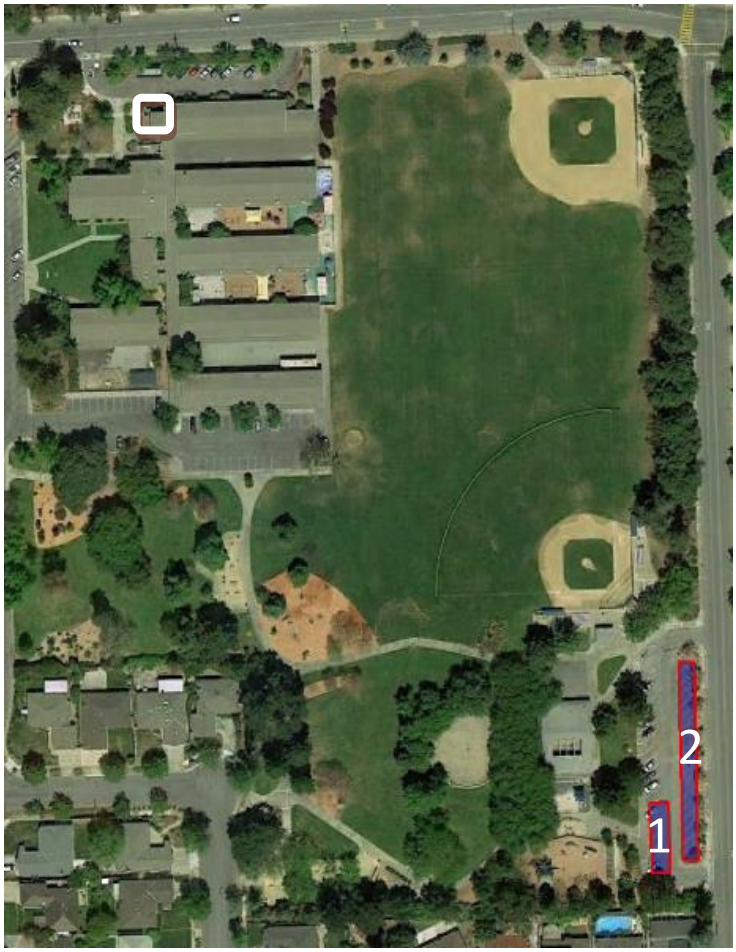


Figure 12: Raynor Well Usable Areas

Using both reviewed sections, a total of 64 kW-DC could be installed at this site. A system of this size is capable of producing 90,208 kWh. This production is more than 160% of the site's yearly electricity usage of 5,480 kWh. From an economic perspective, a much smaller system size of 3.5 kW-DC is recommended for this site. This smaller system would produce 4,933 kWh annually, and would offset 90% of the site's annual electricity usage. However, due to site limitations the recommended system size is not currently possible. Table 7 has more details about the size and PV capacity of each section.

Table 7: Raynor Well Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
1	270°	1,594	19
2	270°	3,747	45
Total		5,341	64
Total System Production (kWh)			90,208
Recommended System Size (kW)			-
Recommended System Output (kWh)			-

The boundaries of Section 1 are limited by the presence of trees located south and west of the parking spots. The boundaries of Section 1 can be extended if the trees are removed or relocated. Section 2 is not affected by the same shading, but several trees would need to be removed to enable construction in the area. A view of Section 2 can be seen in Figure 13 below.

Figure 13: Partial view of Section 2, looking southeast

The main challenge to installing solar PV carports at this site is the distance between the parking lot and the main meter at this site. Extensive trenching will be needed, increasing construction costs. Site voltage is three-phase, 480/277-V and switchgear and main breaker ratings are both 400A. An enclosure will have to be constructed in order to house any additional electrical equipment.

Due to the small recommended system size, with added construction costs required for carport construction and a lengthy electrical run, this site is Not Recommended for solar installation.

San Lucar Pump Station

Site Address: 121 San Lucar Court, Sunnyvale, CA 94086

Type of PV System:	Rooftop
Current PG&E Rate Schedule:	A-6 TOU
Annual Energy Usage:	400,640 kWh
Maximum System Size:	48 kW-DC
Maximum System Output:	67,656 kWh
Recommended System Size:	- kW-DC
Recommended System Output:	- kWh
Energy Offset:	0% recommended

Issues:	No well penetrations; Structural concerns; Tank cleaning schedule; Low energy offset
Opportunities:	None

San Lucar Pump Station is a water pump and storage facility with significant electrical load. Figure 14 shows the usable area on top of the tank at the Pump Station. The location of the electrical room is indicated by the white box in the figure below.

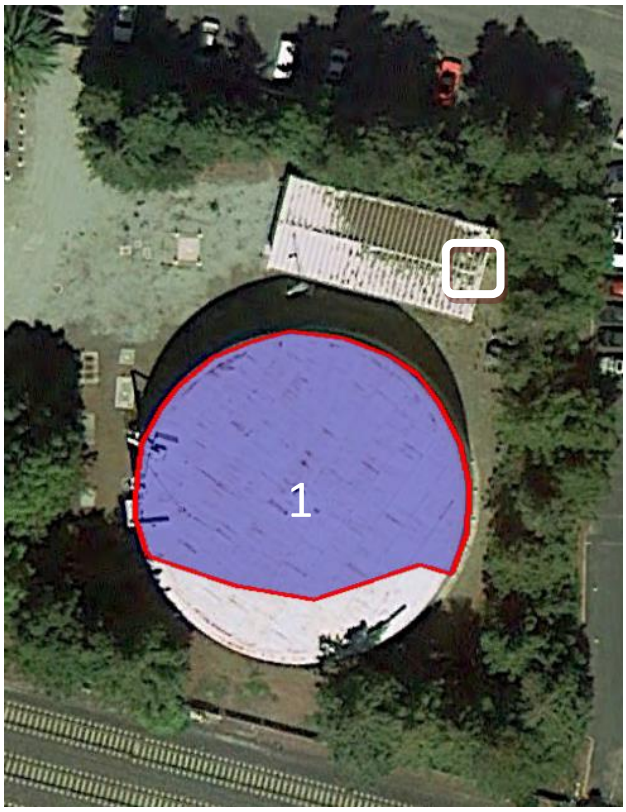


Figure 14: San Lucar Pump Station Usable Area

In order to avoid shading on any installed solar PV panels, the lower portion of the area on top of the tank is not considered usable. The tall trees located south of the tank will cast shade, and block solar access to panels installed outside of the identified usable area.

This site used 400,640 kWh during the past 12 months of operation. From the identified section, a total of 48 kW could be installed. A PV system of that size would produce approximately 67,656 kWh in its first year of operation, which is only 16% of the site's total usage. The PV system is not recommended at this site. Table 8 shows more information about the usable area.

Table 8: San Lucar Pump Station Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
1	180°	4,580	48
Total		4,580	48
Total System Production (kWh)			67,656
Recommended System Size (kW)			-
Recommended System Output (kWh)			-

During the site visit, it was observed that the surface of the tank cap flexes noticeably when weight was applied. A structural review and likely re-roofing will need to be performed if the City pursues installing solar panels here. It was also observed that the roof was not in good condition, as seen in Figure 15.

Figure 15: Sample condition of the tank cap

As at other Sunnyvale water tanks, re-surfacing of the tank cap is performed every 7 years, and would require the removal and replacement of any solar system installed on the tank. The tank cleaning schedule will also affect the performance of a solar PV system since the system will have to be offline during the cleaning cycle.

Site voltage is three-phase, 480/277-V, and switchgear and amperage ratings are both 800-Amp. There is some space within the electrical room, but an inverter will have to be installed outside of the electrical room if the City decides to move forward with a solar PV installation at this site.

Due to the structural concerns and 7 year cleaning schedule, this site is Not Recommended for solar installation. Planning and budgeting for solar at this site must include temporary removal and replacement of rooftop arrays every 7 years.

Serra Well

Site Address: The Dalles Avenue & Hollenbeck Avenue, Sunnyvale, CA 94087

Type of PV System:	Carport
Current PG&E Rate Schedule:	A-1
Annual Energy Usage:	15,920 kWh
Maximum System Size:	131 kW-DC
Maximum System Output:	184,645 kWh
Recommended System Size:	- kW-DC
Recommended System Output:	- kWh
Energy Offset:	0%

Issues:	Limited space near well; Trench distance; Park carport availability;
Opportunities:	Potential high energy offset; Shade structures

Serra Well is located within the boundaries of Serra Park, which is managed by the City of Sunnyvale Public Works department. There are parking spaces near the Serra Well, but due to heavy shading that area is not usable. The usable areas are in the southeast corner of the property at Serra Well, as shown in Figure 16. The electric closet is located at the far northeast end of the property as indicated in the figure below.

Figure 16: Serra Well Usable Areas

Sections 1 through 3 are located over 4 rows of parking spots. Within the identified usable areas, a total of 131 kW-DC can be installed. A system of this size will produce an estimated 184,645 kWh annually. The electricity usage at this site is only 15,920 kWh; therefore, from an economic perspective, a 9 kW-DC system is the recommended size. This smaller system will produce 12,686 kWh each year, offsetting 80% of the energy usage. However, due to physical limitations, the recommended system size is not possible. Table 9 shows more detail about the size and capacity of each section.

Table 9: Serra Well Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
1	270°	3,099	37
2	270°	4,199	50
3	270°	3,737	44
Total		11,035	131
Total System Production (kWh)			184,645
Recommended System Size (kW)			-
Recommended System Output (kWh)			-

Aside from producing energy, the solar PV carports will also provide shade to cars parked underneath. Due to the location of the available usable areas and the well meter extensive trenching will be required to connect the solar PV carports to the electrical connection. Figure 17 is a view of Section 3.

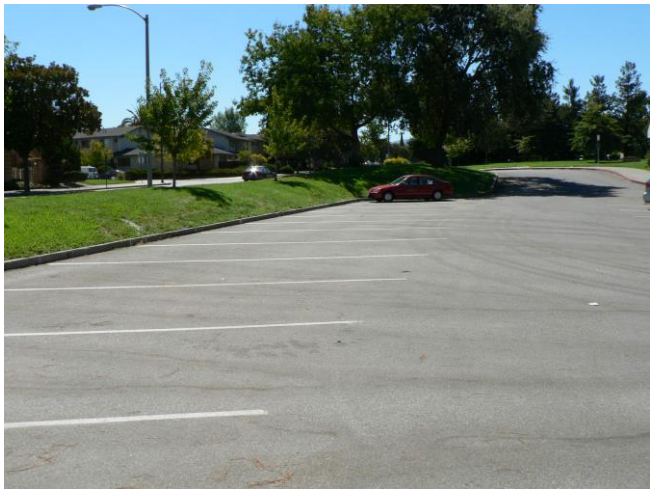


Figure 17: Partial view of Section 3, looking southeast

Figure 18: View of the Electrical Closet

The main electrical meter at this site is indicated by the white box in Figure 16. The electrical closet is outdoors, attached to a structure, as shown in Figure 18. The voltage at this site is480/277V. The main breaker and switchgear amperage rating is 225A. Any additional electrical equipment will have to be installed outdoors.

Due to the small recommended system size, with added construction costs required for carport construction and a lengthy electrical run, this site is Not Recommended for solar installation.

Wolfe - Evelyn Water Plant

Site Address: Britton & McKinley, Sunnyvale, CA 94086

Type of PV System:	Rooftop
Current PG&E Rate Schedule:	A-6 TOU
Annual Energy Usage:	329,760 kWh
Maximum System Size:	140 kW-DC
Maximum System Output:	197,330 kWh
Recommended System Size:	- kW-DC
Recommended System Output:	- kWh
Energy Offset:	60%

Issues:	No well penetrations; Structural concerns; Tank cleaning schedule
Opportunities:	Potential high energy offset;

The Wolfe – Evelyn Water Plant is located in a corner of a residential neighborhood. The site has temporary dirt between tank and the pump building. There is one usable area, the top of the tank, at the Wolfe-Evelyn Water Plant as shown in Figure 19. The white box in the figure below shows the position of the electrical room.

Figure 19: Wolfe-Evelyn Water Plant Usable Areas

A total of 40 kW-DC can be installed at this site. This system will be capable of producing about 197,330 kWh during its first year of operation. This site used 329,760 kWh of electricity in the past 12 months. The possible production is equivalent to 60% of the site's usage. From an economic perspective, the recommended size is 140 kW-DC, but due to site limitations that system size is not possible. Further details about each section can be seen in Table 10.

Table 10: Wolfe-Evelyn Water Plant Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
1	180°	13,406	140
Total		13,406	140
Total System Production (kWh)			197,330
Recommended System Size (kW)			-
Recommended System Output (kWh)			-

The tank at this site is on a 7-year cleaning cycle which includes sanding, resurfacing and repainting. Rust spots on the tank were observed. The top of the tank also flexed during the walk-through. A structural study will need to be conducted to ensure that the tank is able to withstand the additional load of solar PV panels. Figure 20 shows a side view of the tank with signs of algae development.

Figure 20: Partial view of the tank, looking northwest

The main electrical meter at this site is indicated by the white box in Figure 19. The voltage at this site is 480V. The main breaker and switchgear amperage rating is 1000A. There is space within the electrical room for an additional meter, but other electrical equipment such as the inverter must be installed outside the building which houses the electrical room.

Due to the structural concerns and 7 year cleaning schedule, this site is Not Recommended for solar installation. Planning and budgeting for solar at this site must include temporary removal and replacement of rooftop arrays every 7 years.

Wright Avenue Water Plant

Site Address: Chetamon Court, Sunnyvale, CA 94086

Type of PV System:	Rooftop
Current PG&E Rate Schedule:	A-6 TOU
Annual Energy Usage:	154,880 kWh
Maximum System Size:	276 kW-DC
Maximum System Output:	389,023 kWh
Recommended System Size:	- kW-DC
Recommended System Output:	- kWh
Energy Offset:	0%

Issues:	No well penetrations; Structural concerns; Tank cleaning schedule
Opportunities:	Potential high energy offset;

The Wright Avenue Water Plant consists of two large water storage tanks and a small pump building. The pump building is one of the most recently renovated pump buildings in the City. The tanks are approximately 35-feet tall and are located in a residential area. The two usable areas at the Plant are the tops of the tanks, as shown in Figure 21. The white box shows the location of the electrical room.

Figure 21: Wright Avenue Water Plant Usable Areas

From both sections, a total of 276 kW-DC can be installed. This system will be capable of producing about 389,023 kWh during its first year of operation. The site annual electricity usage is 154,880 kWh. Further details about the 2 identified usable areas can be seen in Table 11 below.

Strictly from an economic perspective, the recommended system size for this site is 68 kW-DC, which will produce approximately 95,846 kWh. This estimated production will offset 62% of the site's electrical usage. However, due to physical limitations, the recommended system size is not viable.

Table 11 Wright Avenue Water Plant Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
1	180°	13,047	136
2	180°	13,299	139
Total		26,347	276
Total System Production (kWh)			389,023
Recommended System Size (kW)			**-**
Recommended System Output (kWh)			**-**

The tanks at this site are on a 7-year cleaning cycle which involves sanding, re-surfacing and repainting of the entire tank. For the duration of the cleaning, any solar PV panels installed atop the tanks will need to be offline. Additional challenges include structural concerns as the top of the tank flexed during the walk-through. Figure 22 shows a view of the top of the tank which is in fair condition.

Figure 22: Partial view of Section 1 tank, which is identical to Section 2

As indicated in Figure 21, the electrical room is located in between the tanks. The site has a recently renovated electric closet and transformer. The site voltage is 480V. The switchgear and main breaker amperage rating are both 600A. There is space within the electrical room for additional electrical equipment.

Due to the structural concerns and 7 year cleaning schedule, this site is Not Recommended for solar installation. Planning and budgeting for solar at this site must include temporary removal and replacement of rooftop arrays every 7 years.

Sunken Gardens Lift Station and Golf Range Meter

Site Address: 1010 South Wolfe Road, Sunnyvale, CA 94086

Type of PV System:	Carport
Current PG&E Rate Schedule:	A-1 (Both Meters)
Annual Energy Usage:	73,498 kWh (Lift Meter)
	36,772 kWh (Golf Range Meter)
Maximum System Size:	95 kW-DC
Maximum System Output:	136,071 kWh
Recommended System Size:	- kW-DC (Lift Meter)
	- kW-DC (Golf Range Meter)
Recommended System Output:	- kWh (Lift Meter)
	- kWh (Golf Range Meter)
Energy Offset:	0% (Lift Meter)
	0% (Golf Range Meter)

Issues:	Trench distance; Carport availability; Shade concerns
Opportunities:	High energy offset; Shade structure. Multiple meter offset

The Sunken Garden Lift Station is located within the Sunken Garden Golf Shop parking lot. The parking lot is managed by the City of Sunnyvale Public Works department. The usable areas at Sunken Gardens Lift Station are shown in Figure 23. There are 3 meters at this site: Golf Driving Range Meter, Golf Shop Meter, and Lights, Administration Office and the Lift Station Meter. This feasibility study includes only the Golf Range and Lift meter. The location of the Lift meter is indicated in the figure below by the white box, and the location of the Golf Range meter is assumed to be in the same location.

Figure 23: Sunken Gardens Lift Station Usable Areas

The usable sections are all located in the same parking lot. Solar PV carports can be installed within the highlighted areas. The carports will produce electricity for the site as well as provide shade for parked cars.

Within the 4 highlighted sections, a 95 kW-DC solar PV system can be installed. A system of this size will produce approximately 136,071 kWh annually. However, due to potential structural limitations, installations in Section 3 and 4 are not recommended. In terms of site usage, the Lift Station meter recorded 73,498 kWh and the Golf Range meter recorded 36,772 kWh consumption during the past 12 months. For highest economic return, a smaller system size than maximum system size is recommended for both meters. However, due to shading concerns and required tree removal or relocation requirements this site is not recommended. More details about each section can be found on Table 12.

Table 12: Sunken Garden Lift Station Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)	Lift Station Meter (kW DC)	Golf Range Meter (kW DC)
1	180°	1,179	14		
2	100°	914	11		
3	185°	2,647	33		
4	185°	3,089	37		
Total		7,829	95		
Total System Production (kWh)			136,071		
Recommended System Size (kW)				-	-
Recommended System Output (kWh)				-	-

Figure 24 shows a view of the parking spots south of Section 3. Due to the tall trees, much of the parking spots on this area are in the shade for a large part of the day.

Figure 24: View of the unavailable parking lot, looking southeast

Figure 25: View of Section 3, looking northeast

The voltage at the Lift Station meter is 277/480V. The main breaker and switchgear amperage rating is 400A. There is limited room within the electrical closet for a meter, an inverter, or additional PV equipment. Space is available next to the meter closet. As for the Golf Range meter, the location and ratings for voltage and amperage are not known.

This site is Not Recommended for proceeding with a solar procurement for either meter. Shading concerns and tree removal and/or relocation concerns limit the available installation space, making this site not an ideal location.

Baylands Park Lift Station, Administraion Office, and Storm Drain

Site Address: 999 East Caribbean Drive, Sunnyvale, CA 94089

Type of PV System:	Rooftop / Carport
Current PG&E Rate Schedule:	A-1 (Lift and Park Meter)
	A-6S TOU (Storm Drain Meter)
Annual Energy Usage:	58,960 kWh (Lift Station)
	57,840 kWh (Park Meter)
	76,512 kWh (Storm Drain Meter)
Maximum System Size:	720 kW-DC
Maximum System Output:	1,043,648 kWh
Recommended System Size:	28 kW-DC (Lift Station)
	38 kW-DC (Park Meter)
	0 kW-DC (Storm Drain Meter)
Recommended System Output:	40,620 kWh (Lift Station)
	55,127 kWh (Park Meter)
	0 kWh (Storm Drain Meter)
Energy Offset:	71% (Lift Station)
	69% (Park Meter)
	N/A (Storm Drain Meter)

Issues:	Trench distance; Carport availability; Shade concerns
Opportunities:	High energy offset; Shade structure; Multiple meter offset possibility

There are three main meters at the Baylands Park: Lift Station, Park Administration, and Storm Drain meters. The Lift Station and Park Administration meters are located close to each other, which is directly north of the park entrance. The Baylands Park Lift Station is located northeast of the park entrance, in close proximity to the parking lot. The Storm Drain Station is located in the northeast corner of Baylands Park. There is limited space available near the drain station, as shown in Figure 26. Additional usable area space is available in the Baylands Park parking lot, as shown in Figure 28 (on the next page); however, due to the distance between the parking lot and the storm drain meter, Sections 2-9 are only recommended for Lift Station and Park Administration meters. The white box in Figure 28 indicates the location of the lift station electrical closet.

Figure 26: Baylands Park Storm Drain Usable Area

Section 1 of the usable area is on the rooftop of the storm drain station building, and Section 10 is a potential PV shade structure, outside the building. A 23 kW-DC solar PV system can be installed is these two section. A structural design review is required prior to a solar PV installation. Figure 27 shows view of the building under Section 1 and Section 10. According to the City Staff the storm drain station is expected to be renovated early 2014, converting all gas powered pumps to electric. This would significantly increase the meter's usage.

Figure 27: Side view of the lift station building, which is Section 1

Aside from the Storm Drain Station Building rooftop, the main Baylands Park parking lot, Sections 2 through 9, which are ideal for solar carport installation, are also available for a solar PV installation.

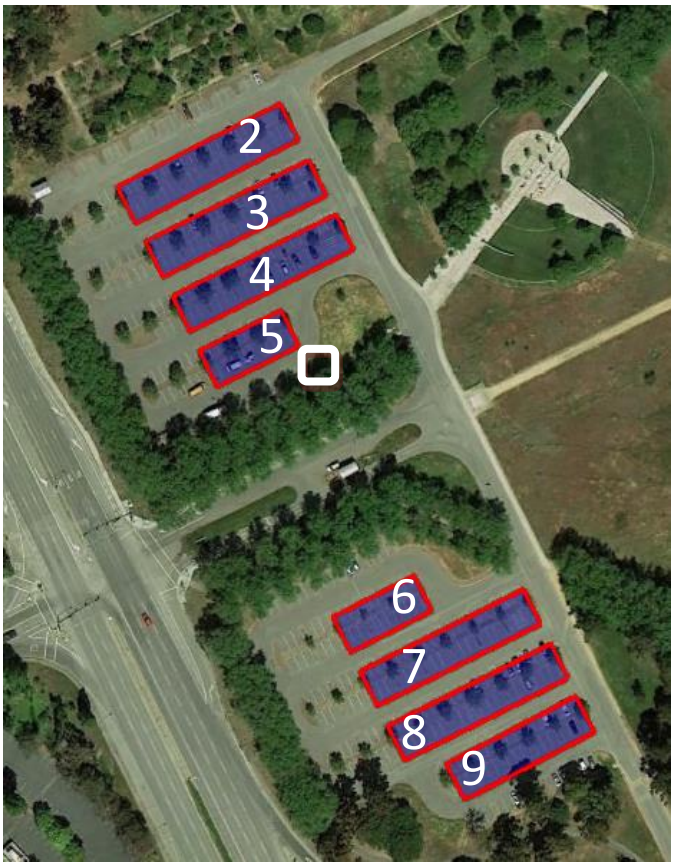


Figure 28: Baylands Park Parking Lot Usable Areas

The Lift Station and Park Administration Office meters are located in this north parking lot area, near Section 5. Both the parking lots are surrounded by trees on north, west, and south side. The parking spots closest to the western row of trees are not considered usable to avoid exposing solar panels to shade. Figure 28 shows a sample of trees in the parking lot that will need to be removed or relocated.

Figure 29: Partial view of the Sections 2 though 4

Within all 10 sections, a total of 720 kW-DC can be installed. This system will be capable of producing about 1,043,648 kWh during its first year of operation. The lift station and Park office meters used 58,960 kWh and 57,840 kWh of electricity, respectively, in the past 12 months. The storm drain meter used 76,512 kWh of electricity used in the past 12 months. The total possible production is equivalent to over 100% of the usage at all three meters. However, due to physical constraints and for highest economic return smaller, 28 kW-DC and 38 kW-DC, PV systems are recommended for the Lift Station and Park Admin Office, respectively. There are no recommendations for the Storm Drain meter. Further details about each section can be seen in Table 13.

Table 13: Baylands Park Lift Station Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)	Lift Station Meter	Park Admin Office Meter	Storm Drain Meter
Rooftop						
1	180°	689	7			
Carport						
2	155°	8,881	106			
3	155°	8,601	102			
4	155°	8,477	101	28	38	
5	155°	4,319	51			
6	155°	4,192	50			
7	155°	8,274	99			
8	155°	8,241	98			
9	155°	7,009	83			
10	180°	1,937	23			
Total		57,993	720			
Total System Production (kWh)			1,043,648			
Recommended System Size (kW)				**28**	**38**	**-**
Recommended System Output (kWh)				**40,620**	**55,127**	**-**

During daylight hours, the energy produced by the PV system flows into the load at the meter, reducing or eliminating the need to purchase electricity from the utility. Excess energy is passed directly onto the utility grid, building up energy credits for the site. These credits are used up at night when the solar system is not generating electricity but utility costs are lower. Given the usage profile and expected solar energy production, a rate schedule change from A-1 to A-6 TOU is highly recommended for the Lift Station and Park Administration meters at the site, if a solar array is interconnected. Under the A-6 rate schedule, essentially, the site sells higher-value energy to the utility company, and uses lower-value energy at night. With a TOU rate schedule the utility bills can be virtually eliminated with smaller, 28 kW-DC and 38 kW-DC, PV system sizes.

Electrical equipment information for the Lift Station and Park Admin Office meter was not available at the time of the site visit. The electrical closet for the Storm Drain meter is located within the pump building. The voltage at the meter is 120/240V. The main breaker and switchgear amperage rating is 200A. The electrical closet is expected to be upgraded with the Storm Drain Pump upgrade project. There is no room within building for any additional PV-related electrical equipment. Space is available adjacent to the building for equipment.

This site is Recommended for proceeding with a solar procurement for the Lift Station and Park Administration meters, since electrical needs can be met by utilizing only 9% of the proposed areas. A rooftop PV array could utilize existing space, providing the benefits of an easier, lower cost installation, while carports in this location could provide useful shade and partial rain cover for visitors, and employees. Solar arrays provide energy to the facility, as well as a visual symbol of Sunnyvale's dedication to greenhouse gas reductions.

SMaRT Station

Site Address: 301 Carl Road, Sunnyvale, CA 94089

Type of PV System:	Rooftop / Carport
Current PG&E Rate Schedule:	E-19S
Annual Energy Usage:	419,369 kWh
Maximum System Size:	558 kW-DC
Maximum System Output:	794,095 kWh
Recommended System Size:	238 kW-DC
Recommended System Output:	346,685 kWh
Energy Offset:	83%

Issues:	Trench distance; Carport availability; Shade concerns
Opportunities:	High energy offset; Shade structure

The SMaRT station building was constructed in 1993. According to a roof service life assessment report[1], provided by the City, the metal standing seam portion of the roof and majority of the mechanical equipment are original from 1993. There are five total usable areas at the site, as shown in Figure 30. The white box shows the location of the electrical closet at this site.

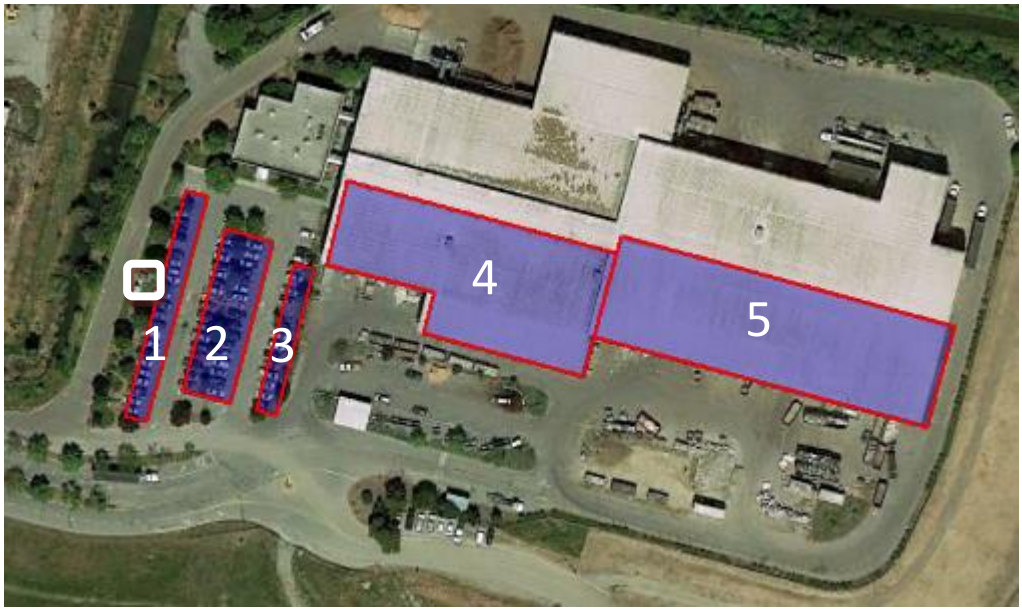


Figure 30: SMaRT Station Usable Areas

Sections 1-3 are the carport sections. Sections 1 and 2 include all the parking spots in their respective rows. There are a few parking spots at the north end of Section 3 that are not considered usable due to shade concerns. Additionally, there are trees in all the carport sections that would need to be removed and or relocated prior to an installation.

[1] "Sunnyvale Recycling Center Roof Service Life Assessment" report prepared by Gale Associates, Inc on 11 May, 2012

Sections 4 and 5 are the rooftop sections. According to the original site drawings the roof has a 1:12 slope. The roof panels are 24 inch wide and have a 3 in high standing seam. A structural review will need to be conducted in order to verify that the roof is capable of supporting the additional weight of solar PV panels and associated racking.

Figure 31: Partial view of Section 4, looking northwest

A total of 558 kW-DC can be installed within the identified usable sections. This system will be capable of producing about 794,095 kWh annually. This site used 419,369 kWh of electricity during the most recent 12 months. The possible production is over 100% of the site's usage. For highest economic return a smaller, 238 kW-DC, PV system is recommended. Further details about each section can be seen in Table 14.

Table 14: SMaRT Station Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
Rooftop			
4	190°	20,499	214
5	190°	17,847	183
Carport			
1	105°	4,242	51
2	105°	6,718	80
3	105°	2,547	30
Total		51,493	558
Total System Production (kWh)			794,095
Recommended System Size (kW)			**238**
Recommended System Output (kWh)			**346,685**

During daylight hours, the energy produced by the PV system flows into the load at the meter, reducing or eliminating the need to purchase electricity from the utility. Excess energy is passed directly onto the utility grid, building up energy credits for the site. These credits are used up at night when the solar system is not generating electricity but utility costs are lower. Given the usage profile and expected solar energy production, a rate schedule change from E-19S to A-6 TOU is highly recommended for this site, if a solar array is interconnected. Under the A-6 rate schedule, essentially, the site sells higher-value energy to the utility company, and uses lower-value energy at night. With a TOU rate schedule the utility bill can be virtually eliminated with a smaller, 238 kW-DC PV system.

The electrical closet is closer to the carport sections than the rooftop sections. The voltage at this site is 480/277V. The main breaker and switchgear amperage rating is 3000A. There is no room within this enclosure for any additional PV-related electrical equipment. Space is available adjacent to this enclosure for equipment.

This site is Recommended for proceeding with a solar procurement, since electrical needs can be met by utilizing only 43% of the proposed areas. A rooftop PV array could utilize existing space, providing the benefits of an easier, lower cost installation, while carports in this location could provide useful shade and partial rain cover for visitors, and employees. Solar arrays provide energy to the facility, as well as a visual symbol of Sunnyvale's dedication to greenhouse gas reductions.

Landfill

Site Address: 1444 Borregas Avenue, Sunnyvale, CA 94089

Type of PV System:	Ground Mount
Current PG&E Rate Schedule:	Not Applicable
Annual Energy Usage:	Not Applicable
Maximum System Size:	8,344 kW-DC
Maximum System Output:	13,150,819 kWh
Recommended System Size:	5,000 kW-DC
Recommended System Output:	7,880,404 kWh
Energy Offset:	Not Applicable

Issues:	Trench distance; Landfill settlement concerns; PV Racking design; Interconnection Location
Opportunities:	High energy generation; High visibility

The City of Sunnyvale Landfill site was finished and capped in 1994. The Landfill has a composite liner cap, with a 2' vegetative soil layer underlain by 1' clay layer. The 1' clay layer is underlain by a 1' "structural" layer of soil, comprising the landfill cover. According to a 2010 differential study the Landfill has experienced relatively uniform settlement in the identified four usable sections shown in Figure 32 below. A potential interconnection location for the landfill PV solar array is shown by a white box in the figure below, which is the same location as the SMaRT Station.

Figure 32: Landfill Usable Areas

Portions of the identified sections experienced, in excess to 1' of settlement, with minimal areas, as much as 3' of settlement over the course of five years. The boundaries of each section are dictated by the existing conditions at the site. These sections are on unused portions of land. Section 1, West Hill, is steeper than Section 3 and 4 as shown in Figure 33. The top portion of Section 1 may be used in the future for a recreational program.

Figure 33: Partial view of Section 1, West Hill, looking southwest

Section 2 is located south of the recycling building. This section is the oldest capped section and has experienced the least amount of settlement over the past five years. Figure 34 shows a partial view of Section 2.

Figure 34: Partial view of Section 2, Recycle Hill, looking southeast

Section 3 and 4 are located on the eastern hill. Both of the sections have grazing animals that may damage the panels. Additionally, all of the landfill sections are on borrowing owl habitat. The City environmental department, and multiple regulatory agencies' approvals, are required prior to an installation. Figure 35 and Figure 36 show partial views of Sections 3 and 4, respectively.

Figure 35: Partial view of Section 3, South Hill looking southwest

Figure 36: Partial view of Section 4, East Hill, looking southeast

From all 4 sections, a total of 8.3 MW can be installed. This system will be capable of producing over 13 million kWh during its first year of operation. The energy usage at this site is not currently tracked. The recommended size is 5 MW, which will produce over 7 million kWh. Table 15 shows more details about each individual section.

Table 15: Landfill Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
1	190°	160,494	1,911
2	190°	102,544	1,221
3	190°	202,138	2,406
4	190°	235,680	2,806
Total		700,856	8,344
Total System Production (kWh)			13,150,819
Recommended System Size (kW)			**5,000**
Recommended System Output (kWh)			7,880,404

Given the ample space, a 5MW recommended system size is due to current allowable maximum system size. The City may consider using this site as part of a community solar program. But, according to staff discussion, this site is considered part of City Parks, which makes it a high premium lot.

Currently there is no electrical equipment at this site. A potential electrical interconnection location, the SMaRT Station meter, is shown in Figure 32 above.

Wastewater Treatment Plant Retention Ponds

Site Address: 1444 Borregas Avenue, Sunnyvale, CA 94089

Type of PV System:	Floating Photovoltaic
Current PG&E Rate Schedule:	Not Applicable
Annual Energy Usage:	Not Applicable
Maximum System Size:	120 MW-DC
Maximum System Output:	193,164,284 kWh
Recommended System Size:	5 MW-DC
Recommended System Output:	8,036,925 kWh
Energy Offset:	Not Applicable

Issues:	Unique PV racking design; Interconnection location
Opportunities:	High energy generation; High visibility

The Retention Ponds are part of the City of Sunnyvale Wastewater Treatment Plant. The ponds are located north of the plant and the usable areas are shown in Figure 37. The recommended solution for the two usable areas is a floating solar photovoltaic system.

Figure 37: Wastewater Treatment Plant Retention Ponds Usable Areas

Due to limited available land space a floating PV system may be a cost effective solution for the City. In general the floating PV systems are designed as large ground mounts, taking into account water level fluctuation, wind, and site specific environmental factors.

A 120 MW solar PV system can be installed within the highlighted sections. A system of this size will be capable of producing over 193 million kWh. The suggested size is 5MW. Table 16 shows details about each section.

Table 16: Wastewater Treatment Plant Retention Ponds Possible PV System Summary

Section	Azimuth	Area (Sq. Ft.)	Size (kW DC)
1	180°	8,625,735	90,233
2	180°	2,862,145	29,941
Total		11,487,879	120,173
Total System Production (kWh)			193,164,284
Recommended System Size (kW)			**5,000**
Recommended System Output (kWh)			**8,036,925**

Given the ample space, a 5MW recommended system size is due to current allowable maximum system size. The City may consider using this site as part of a community solar program. Sample successfully completed floating PV arrays are shown below in Figure 38 and Figure 39.

Figure 38: Partial view of Napa Valley 1.2MW floating PV array

Figure 39: Sample view of Sonoma County 400kW array

As for the retention ponds, Figure 40 shows a view of Section 1 and Section 2.

Figure 40: Partial view of Section 1 and 2 ponds

In terms of system design, a floating PV system generally uses a high density polyethylene shell with foamed polystyrene floatation. The array is anchored with a wire pulley system that allows for water level change at various parts of the array. The array uses marine grade wires with ample slack to also allow for varying water level change. All of the equipment would need to be NEC compliant to ensure highest level of installation and equipment.

Currently there is no electrical equipment at this site. A potential electrical interconnection location will need to be determined at the time of system design.

Renewable Energy Self-Generating - Bill Credit Transfer (RES-BCT)

Renewable Energy Self-Generating – Bill Credit Transfer (also known as remote generation) is the program that enables solar energy generated at one location (the Host Facility) to be sent to the electric grid and the utility credits the Host customer's bill for the energy delivered at the Time-Of-Use (TOU) rate which the facility would normally pay. This may result in an excess credit in dollars which can then be applied to up to 50 other designated accounts (Benefitting Accounts) that are related to the same customer. By utilizing RES-BCT, sites with existing electrical usage, but no significant physical space for a solar installation, are enabled to take advantage of solar energy produced at alternate sites with enough space to produce energy in excess of their electrical usage. A slight variation on this idea is aggregated net metering, which essentially accomplishes the same goal by monitoring multiple accounts under one customer, and then applying solar-generated energy, or credit for it, to all managed accounts according to time of production.

On September 28, 2008, Governor Schwarzenegger signed into law a bill known as AB 2466, which called for the allowance of energy generation at large sites to be passed through as credits to benefitting accounts under the same host customer. This bill was intended to allow local agencies such as Cities, Counties, and School Districts, to reduce overall energy use and resulting carbon dioxide emissions across entire portfolios of sites. Recognizing that not all sites are good candidates for solar installations, RES-BCT allows excess energy created (or more specifically, a dollar credit for energy produced) to offset energy usage at sites where solar installations are not feasible.

On January 8, 2009, the California Public Utilities Commission (CPUC) held a public workshop to discuss the administration of the program, which was to affect the largest electrical utility companies in the state: Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E). As a group, these companies are known as Investor-Owned Utilities (IOU's). After the workshop, both the IOU's and many interested parties in local government and the renewable energy industry issued requests for clarification and suggestions on interpretation. On April 26, 2010, the CPUC issued its final ruling on the administration of the program, summarized by the points below:

- The official name of the program for all IOU's is the Renewable Energy Self-Generation Bill Credit Transfer Program, or RES-BCT.
- Under RES-BCT, program participants are limited to public agencies who would be able to name a generating, or host, facility at which excess energy generation would be exported to the utility grid, with monetary credit accumulating at the generation component of the applicable bundled utility rate at time of production.
- The customer would name a benefitting account or several benefitting accounts to receive monetary credit from production at the generating facility, which could be applied towards the generation component of the applicable bundled utility rate at time of use.
- Both generating facility and benefitting accounts are required to take utility service under a Time-Of-Use rate schedule.

However, as of June 30, 2012, no entity has applied for participation in the program. The primary reason for the lack of interest is that the program does not allow for net metering. Net metering enables excess energy generated to be credited at the same monetary level as the utility price at time of production. For example, summer energy usage during peak times (noon-6pm) costs $0.49384/kWh for facilities using an A-6 TOU rate schedule. Under net metering, if a solar system on a government facility were to generate 1,000 kWh more than needed during peak summer hours the facility would have earned a credit of $493.84 ($0.49384/kWh x 1,000 kWh). This credit would then be used to pay down electricity usage at times when solar is not producing enough energy to cover facility needs, such as at night. Savings are generated because energy usage on the same the A-6 TOU rate schedule is $0.14163/kWh for off-peak (9:30pm-8:30am) summer energy usage. This price

difference creates the situation where every excess kWh produced and exported to the grid during peak summer hours, can purchase almost 3.5 kWh of energy usage during off-peak summer hours.

Energy credits and debits are tracked hourly and monthly, with an annual "true-up" at which the customer pays for any energy that has not been offset by solar production. However, any excess credit at the end of an annual "true-up" period cannot be monetized or used the following "true-up" period. But, if there is excess energy, not credit, exported onto the grid, per Assembly Bill 920, the energy can be credited at the Market Price Referent, which changes quite frequently.

Under the RES-BCT program, not all energy production is net metered. The energy consumed by the facility with the solar system is net metered: if it offsets the energy usage at the moment it's produced, that energy is not billed, meaning full price value is given to that energy production. However, if the energy is not needed by the host facility, the energy gets exported to the grid (like net metering), BUT a credit is issued only for the *Generation* component of the bundled TOU rate, which is typically only 1/3 to 1/2 the value of the full price of energy to the facility. The result is that excess summer peak production is only worth $0.26041/kWh, while partial-peak summer energy produced before noon is only credited at $0.11394/kWh. Compare these numbers with the prices charged by the utility for energy usage at the same times: $0.49384 and $0.2421, respectively. Winter solar production exports between 8:30am and 9:30pm are only valued at $0.08432/kWh, about half the price charged by the utility of $0.15915/kWh for usage during the same hours. Because all excess generation is exported, with credit also exported to other sites, the remaining electricity bill at the host facility can never be completely offset by solar generation under the RES-BCT program.

For the City of Sunnyvale, Optony was requested to perform analysis of the viability of participating in PG&E's RES-BCT program for two sites: Corporation Yard and SMaRT Station. Both the City sites have enough available space to build large solar arrays that could produce excess energy for export to the utility grid. Optony researched sources such as the CPUC, PG&E, CEC, DSIRE, and various legal and legislative web-sites to investigate the latest rulings, eligibility, processes and opportunities. Interviews and discussions were conducted with PG&E, and solar industry contacts to refine and develop this report, analysis, and recommendations.

In addition to RES-BCT, other existing programs were reviewed for applicability to meeting the goals of the City of Sunnyvale:

- Renewable Market Adjustment Tariff Feed in Tariff (ReMAT FIT) – The ReMAT FIT program was established to implement SB 32. ReMAT allows PG&E 10, 15, and 20- year Power Purchase Agreement to purchase wholesale power generated from systems sized up to 3MW-AC. The program became effective on July 24, 2013 and currently has 110.038 MW-AC capacity remaining. These types of projects cannot be net metered, nor are they eligible for utility incentive programs. For 2013 FIT projects, PG&E will pay a base-rate of up to $0.08923/kWh for 20-year contracts.
    - Currently, these types of projects are unlikely to provide the same type of financial benefit as net metering a solar project sized to meet on-site usage. However, as solar prices continue to fall, and the MPR continues to rise, development of an FIT project on a large City-owned property may be worthy of consideration.
- Excess Generation – Assembly Bill 920 was signed into law on October 11, 2009, and it mandates that the IOU's pay customers for production over the level of usage at net-metered sites. On June 9, 2011, the CPUC approved the rate (the Net Surplus Compensation, or NSC, rate) that the utilities are required to pay. This rate is based on a rolling 12-month average of spot market generation prices. Currently, the rate is approximately $0.04/kWh.

It is important to note that this over-production valuation is for excess electricity, not excess net metering credits. Typically, net metered sites on the A-6 TOU tariff only need to offset 75-80% of facility energy usage to fully eliminate the bill. This is due to the valuation of solar energy at the time of production, as discussed above. If a PV system were sized to offset 95% of facility energy usage, this would usually create a bill credit that the facility would not be able to use. Because the energy

production of the PV is still under the energy usage level, this excess production would still not be eligible for payment under the rules of AB 920. Additionally, to qualify for a Net Energy Metering (NEM) agreement with PG&E, a PV system cannot be intentionally sized to produce more energy than can be used on-site. This stipulation, along with the inability to capture bill credits unless energy usage is surpassed, makes AB 920 unlikely to be used often.

RES-BCT Analysis

Corporation Yard

For the purpose of modeling the economic benefit of solar installation possibilities utilizing RES-BCT, a sample host site that has enough space to build a large solar array, with not enough electrical consumption to use all the energy produced, is needed. The Corporation Yard uses about 47,780 kWh annually, with yearly bills around $9,100 on the current A-10 S TOU electricity rate schedule. Without RES-BCT, and an A-6 TOU rate schedule change, the site should install a 25 kW-DC solar PV system, nearly eliminating the electricity bill of approximately $8,400 per year, which equates to savings of $338/kW-DC. These savings are based on net metering of the solar system, with that system appropriately sized to "zero out" the electricity bill without generating excess bill credits that could be lost at the annual true-up.

However, the Corporation Yard is large enough to host a solar system of nearly 597 kW-DC. A system of this size could produce about 855,725 kWh annually, but such over-sized systems are currently not allowed under PG&E's NEM agreement restrictions. If it were eligible, under a net metering plan, much of the energy produced would be exported to the grid and substantial credits would be generated. However, at the annual true-up, any energy credits not used by the Corporation Yard would be lost, meaning the utility would receive the energy for free, and the City of Sunnyvale would receive no additional return on the solar investment.

With the excess capacity for solar development at the site, the Corporation Yard could be a good candidate for a host facility under an aggregated net metering program. Until such a program is successfully instituted, the closest alternative is the RES-BCT program currently available. Based upon site electricity usage patterns, sample daily cash flows under the RES-BCT program are shown on the following page:

Table 17: Sample RES-BCT and NEM daily cash flows

	Data for Sample Summer Day (May-October) - REC-BCT					Data for Sample Summer Day (May-October) -NEM			
Hour of day	Estimated Energy Usage (kWh)	Solar Production - 597 kW System (kWh)	Billing Rates ($/kWh)	Generation-Only Energy Export Credit Rates ($/kWh)	Hourly Crediting (RES-BCT) ($)	Estimated Energy Usage (kWh)	Solar Production - 25 kW System (kWh)	Billing Rates ($/kWh)	Hourly Crediting (NEM) ($)
1	5.97	0	0.14163	0.05590	($0.85)	5.97	0	$0.14163	($0.85)
2	5.97	0	0.14163	0.05590	($0.85)	5.97	0	$0.14163	($0.85)
3	5.97	0	0.14163	0.05590	($0.85)	5.97	0	$0.14163	($0.85)
4	5.97	0	0.14163	0.05590	($0.85)	5.97	0	$0.14163	($0.85)
5	5.97	0	0.14163	0.05590	($0.85)	5.97	0	$0.14163	($0.85)
6	5.97	0	0.14163	0.05590	($0.81)	5.97	0	$0.14163	($0.84)
7	5.97	74.46	0.14163	0.05590	$3.83	5.97	3.12	$0.14163	($0.40)
8	3.82	174.64	0.14163	0.05590	$9.55	3.82	7.31	$0.14163	$0.49
9	0.68	224.20	0.24210	0.11394	$25.47	0.68	9.39	$0.24210	$2.11
10	0.68	364.03	0.24210	0.11394	$41.40	0.68	15.24	$0.24210	$3.53
11	0.68	422.74	0.24210	0.11394	$48.09	0.68	17.70	$0.24210	$4.12
12	0.68	445.16	0.24210	0.11394	$50.64	0.68	18.64	$0.24210	$4.35
13	0.65	465.53	0.49384	0.26041	$121.06	0.65	19.49	$0.49384	$9.30
14	0.65	450.52	0.49384	0.26041	$117.15	0.65	18.87	$0.49384	$8.99
15	0.65	399.77	0.49384	0.26041	$103.93	0.65	16.74	$0.49384	$7.94
16	0.65	334.35	0.49384	0.26041	$86.90	0.65	14.00	$0.49384	$6.59
17	0.65	240.33	0.49384	0.26041	$62.41	0.65	10.06	$0.49384	$4.65
18	13.06	131.06	0.49384	0.26041	$30.73	13.06	5.49	$0.49384	($3.74)
19	16.96	12.20	0.24210	0.11394	($1.15)	16.96	0.51	$0.24210	($3.98)
20	16.96	0	0.24210	0.11394	($4.11)	16.96	0	$0.24210	($4.11)
21	16.96	0	0.24210	0.11394	($4.11)	16.96	0	$0.24210	($4.11)
22	16.96	0	0.24210	0.11394	($4.11)	16.96	0	$0.24210	($4.11)
23	5.97	0	0.14163	0.05590	($0.85)	5.97	0	$0.14163	($0.85)
24	5.97	0	0.14163	0.05590	($0.85)	5.97	0	$0.14163	($0.85)
Total	**144.42**	**3,739.26**	**Total Daily Billing**		**$10.53**	**144.42**	**156.59**	**Total Daily Billing**	**($27.21)**
			Total Daily Energy Export Credit		**$670.44**			**Total Daily Energy Export Credit**	**$52.08**
Total Annual Billing - 597 kW					**($7,089.25)**	**Total Annual Billing - 25 kW**			**($7,484.66)**
Total Annual Energy Export Credit - 597 kW					**$108,236.33**	**Total Annual Energy Export Credit -25 kW**			**$8,438.90**
Ratio ($/kW) of 1st year credit to installed system size					**$169**	**Ratio ($/kW) of 1st year credit to installed system size**			**$338**

Under the RES-BCT program, billing would take place monthly, but for the example day above, the City would be credited for $10.53, with a generation credit applied to Benefitting Accounts of $670.44. Over the course of a year, this facility would be expected to accrue a bill of approximately $7,089, with about $108,236 of export credits generated. The net cash flow would equal $101,147, which, when spread over the 855,725 kWh of production, gives a value of $0.1265 per kWh generated. Broken down by kW of system size, $101,147 of savings for a 597 kW system gives a value of slightly over $169/kW of annual savings. With a system cost of approximately $4/Watt, simple payback (ignoring PG&E rate increases and discount rate) comes out to about 24 years, compared to the 12-year simple payback under the net metering option at $338/kW of savings, as discussed above.

Taking the same sample day, under Net Energy Metering and Optony recommended smaller 25 kW system size, which is 4.2% of the maximum system size, the City would be billed for $27.21, with a generation credit of $52.08. Over the course of a year, this facility would be expected to accrue a bill of approximately $7,485, with about $8,439 of export credits generated. The net cash flow would equal $954, which results in a simple payback of 10 year. Therefore, a smaller system that offsets the Corp Yard is recommended at this time.

SMaRT Station

For the purpose of modeling the economic benefit of solar installation possibilities utilizing RES-BCT, a sample host site that has enough space to build a large solar array, with not enough electrical consumption to use all the energy produced, is needed. The SMaRT Station uses about 419,369 kWh annually, with yearly bills around $100,000 on the current E-19SV electricity rate schedule. Without RES-BCT, the site should install a 241 kW-DC solar PV system, nearly eliminating the electricity bill of approximately $35,000 per year, which equates to savings of $147/kW-DC. These savings are based on net metering of the solar system, with that system appropriately sized to "zero out" the electricity bill without generating excess bill credits that could be lost at the annual true-up.

However, the SMaRT Station is large enough to host a solar system of nearly 558 kW-DC. A system of this size could produce about 794,095 kWh annually, but such over-sized systems are currently not allowed under PG&E's NEM agreement restrictions. If it were eligible, under a net metering plan, much of the energy produced would be exported to the grid and substantial credits would be generated. However, at the annual true-up, any energy credits not used by the SMaRT Station would be lost, meaning the utility would receive the energy for free, and the City of Sunnyvale would receive no additional return on the solar investment.

With the excess capacity for solar development at the site, the SMaRT Station could be a good candidate for a host facility under an aggregated net metering program. Until such a program is successfully instituted, the closest alternative is the RES-BCT program currently available. Based upon site electricity usage patterns, sample daily cash flows under the RES-BCT program are shown on the following page:

Table 18: Sample RES-BCT and NEM daily cash flows

	Data for Sample Summer Day (May-October) - REC-BCT					Data for Sample Summer Day (May-October) -NEM			
Hour of day	Estimated Energy Usage (kWh)	Solar Production - 558 kW System (kWh)	Billing Rates ($/kWh)	Generation-Only Energy Export Credit Rates ($/kWh)	Hourly Crediting (RES-BCT) ($)	Estimated Energy Usage (kWh)	Solar Production - 241 kW System (kWh)	Billing Rates ($/kWh)	Hourly Crediting (NEM) ($)
1	33.33	0	$0.14163	$0.0559	($4.72)	33.33	0	$0.14163	($4.72)
2	33.01	0	$0.14163	$0.0559	($4.68)	33.01	0	$0.14163	($4.68)
3	31.59	0	$0.14163	$0.0559	($4.47)	31.59	0	$0.14163	($4.47)
4	32.13	0	$0.14163	$0.0559	($4.55)	32.13	0	$0.14163	($4.55)
5	34.59	0	$0.14163	$0.0559	($4.90)	34.59	0	$0.14163	($4.90)
6	47.11	2.09	$0.14163	$0.0559	($6.38)	47.11	1	$0.14163	($6.54)
7	46.48	102.56	$0.14163	$0.0559	$3.13	46.48	44.29	$0.14163	($0.31)
8	57.66	199.98	$0.14163	$0.0559	$7.96	57.66	86.37	$0.14163	$4.07
9	55.72	228.30	$0.24210	$0.1139	$19.66	55.72	98.60	$0.24210	$10.38
10	53.31	359.23	$0.24210	$0.1139	$34.86	53.31	155.15	$0.24210	$24.66
11	53.13	403.16	$0.24210	$0.1139	$39.88	53.13	174.12	$0.24210	$29.29
12	52.39	413.13	$0.24210	$0.1139	$41.10	52.39	178.43	$0.24210	$30.51
13	52.21	421.76	$0.49384	$0.2604	$96.23	52.21	182.16	$0.49384	$64.17
14	40.95	399.26	$0.49384	$0.2604	$93.31	40.95	172.44	$0.49384	$64.94
15	40.90	346.74	$0.49384	$0.2604	$79.64	40.90	149.76	$0.49384	$53.76
16	42.88	282.64	$0.49384	$0.2604	$62.44	42.88	122.07	$0.49384	$39.11
17	41.07	192.23	$0.49384	$0.2604	$39.37	41.07	83.03	$0.49384	$20.72
18	36.77	97.86	$0.49384	$0.2604	$15.91	36.77	42.26	$0.49384	$2.71
19	33.31	5.51	$0.24210	$0.1139	($6.73)	33.31	2	$0.24210	($7.49)
20	39.55	0	$0.24210	$0.1139	($9.57)	39.55	0	$0.24210	($9.57)
21	34.31	0	$0.24210	$0.1139	($8.31)	34.31	0	$0.24210	($8.31)
22	38.35	0	$0.24210	$0.1139	($9.28)	38.35	0	$0.24210	($9.28)
23	32.27	0	$0.14163	$0.0559	($4.57)	32.27	0	$0.14163	($4.57)
24	37.03	0	$0.14163	$0.0559	($5.24)	37.03	0	$0.14163	($5.24)
Total	**1,000.03**	**3,454.43**	**Total Daily Billing**		**($57.50)**	**1,000.03**	**1,491.97**	**Total Daily Billing**	**($71.93)**
			Total Daily Energy Export Credit		**$517.58**			**Total Daily Energy Export Credit**	**$341.61**
Total Annual Billing - 558 kW					**($31,630.23)**	**Total Annual Billing - 241 kW**			**($37,131.85)**
Total Annual Energy Export Credit - 558 kW					**$67,602.09**	**Total Annual Energy Export Credit -241 kW**			**$35,384.71**
Ratio ($/kW) of 1st year credit to installed system size					**$64**	**Ratio ($/kW) of 1st year credit to installed system size**			**$147**

Under the RES-BCT program, billing would take place monthly, but for the example day above, the City would be billed for $57.50, with a generation credit applied to Benefitting Accounts of $517.58. Over the course of a year, this facility would be expected to accrue a bill of approximately $31,630, with about $67,602 of export credits generated. The net cash flow would equal $35,972, which, when spread over the 794,095 kWh of production, gives a value of $0.04529 per kWh generated. Broken down by kW of system size, $35,972 of savings for a 558 kW system gives a value of slightly over $64/kW of annual savings. With a system cost of approximately $4/Watt, simple payback (ignoring PG&E rate increases and discount rate) comes out to about 63 years, compared to the 28-year simple payback under the net metering option at $147/kW of savings, as discussed above.

Taking the same sample day, under Net Energy Metering and Optony recommended smaller 241 kW system size, which is 43% of the maximum system size, the City would be billed for $71.93, with a generation credit of $341.61. Over the course of a year, this facility would be expected to accrue a bill of approximately $37,132, with about $35,385 of export credits generated. The net cash flow would equal a bill of $1,747, which results in a simple payback of 10 year. Therefore, a smaller system that offsets the SMaRT Station is recommended at this time.

Recommendation

Without the ability to net meter, the costs of installing PV systems larger than needed to offset on-site loads cannot be effectively recovered. Payback periods for direct investment are unacceptably long, and negative cash flow for financed options would not turn around for the life of the financing agreement. Optony recommends that the City does not pursue utilization of the RES-BCT program in its current iteration, and at current solar industry pricing. Net metering solar installations to meet on-site consumption can be quite beneficial to the City, and should be considered in the near term, but over-production to export excess energy credits is not financially viable at this time.

Environmental and Economic Impact

From a total of 12 City utility sites, if the City decides to pursue solar installations at the four recommended sites, there will be a significant environmental and economic impact to the City of Sunnyvale and its neighboring communities.

From an economic perspective, this solar project could create approximately $3.7M in new, local economic activity and about 6 additional jobs, in addition to generating substantial energy cost savings for the City of Sunnyvale. If the City were to pursue a direct purchase of the systems, there would be substantial long-term benefits and a positive return on investment from the effort when competitively bid. A summary of the economic benefits for only the recommended sites is shown in Figure 41.

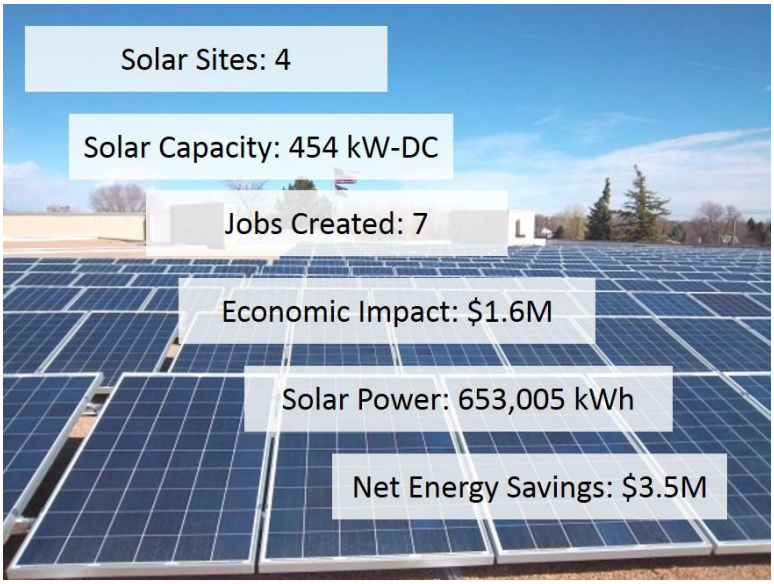


Figure 41: Snapshot of Economic Benefits

Optony performed a detailed financial analysis of the recommended sites and PV system sizes. Detailed below are site specific recommendations with City preferred financing option for all the sites.

Table 19: Site Recommendations

Site Name	Recommended System Size (kW-DC)	Action	Financing	Direct Purchase Financial Savings/Cost	Loan/Lease Financial Savings/Cost	PPA Financial Savings/Cost
Corporation Yard	25	Procurement Recommended	DP/PPA	$120,811 - $181,677	$113,466 - $174,333	$92,849 - $153,716
Hamilton Well / Water Plant	-	Procurement Not-Recommended	-	-	-	-
Mary-Carson Water Plant	-	Procurement Not-Recommended	-	-	-	-
Ortega Well	122	Procurement Recommended	DP/PPA	$441,564 - $721,471	$404,057 - $685,558	$367,562 - $626,687
Raynor Well	-	Procurement Not-Recommended	-	-	-	-
San Lucar Pump Station	-	Procurement Not-Recommended	-	-	-	-
Serra Well	-	Procurement Not-Recommended	-	-	-	-
Wolfe-Evelyn Water Plant	-	Procurement Not-Recommended	-	-	-	-
Wright Avenue Water Plant	-	Procurement Not-Recommended	-	-	-	-
Sunken Garden - Lift Meter	-	Procurement Not-Recommended	-	-	-	-
Sunken Garden - Golf Range Meter	-	Procurement Not-Recommended	-	-	-	-
Baylands Park - Lift Meter	28	Procurement Recommended	DP/PPA	$165,217 - $233,254	$159,074 - $227,112	$112,272 - $180,309
Baylands Park - Park Meter	38	Procurement Recommended	DP/PPA	$124,798 - $190,119	$116,462 - $181,783	$52,945 - $118,266
Baylands Park - Storm Lift Meter	-	Procurement Not-Recommended	-	-	-	-
SMaRT Station	241	Procurement Recommended	DP/PPA	$1,600,807 - $2,235,024	$1,547,939 - $2,182,157	$1,153,357 - $1,787,575
Total for City Utility Solar Sites				**$2,453,196 - $3,561,546**	**$2,340,999 - $3,450,943**	**$1,778,985 - $2,866,552**
Landfill	5,000	Awaiting Assembly Bill	-	$1,329,567 - $7,262,020	-$139,266 - $5,793,187	-$5,489,996 - $442,457
Water Treatment Plant Retention Ponds	5,000	Awaiting Assembly Bill	-	$2,851,908 - $9,188,363	$1,383,074 - $7,719,530	-$4,520,706 - $1,815,750
Total for Community Solar Sites				**$4,181,474 - $16,450,384**	**$1,243,808 - $13,512,717**	**-$10,010,702 - $2,258,207**
Total for All Sites				**$6,634,670 - $20,011,929**	**$3,584,807 - $16,963,660**	**-$8,231,716 - $5,124,760**

For simplicity, Table 20, below, provides actions for Optony recommended sites.

Table 20: Savings/Cost for Optony Recommended Sites

Site Name	Recommended System Size (kW-DC)	Action	Financing	Direct Purchase Financial Savings/Cost	Loan/Lease Financial Savings/Cost	PPA Financial Savings/Cost
Corporation Yard	25	Procurement Recommended	DP/PPA	$120,811 - $181,677	$113,466 - $174,333	$92,849 - $153,716
Ortega Well	122	Procurement Recommended	DP/PPA	$441,564 - $721,471	$404,057 - $685,558	$367,562 - $626,687
Baylands Park - Lift Meter	28	Procurement Recommended	DP/PPA	$165,217 - $233,254	$159,074 - $227,112	$112,272 - $180,309
Baylands Park - Park Meter	38	Procurement Recommended	DP/PPA	$124,798 - $190,119	$116,462 - $181,783	$52,945 - $118,266
SMaRT Station	241	Procurement Recommended	DP/PPA	$1,600,807 - $2,235,024	$1,547,939 - $2,182,157	$1,153,357 - $1,787,575
Total for City Utility Solar Sites				**$2,453,196 - $3,561,546**	**$2,340,999 - $3,450,943**	**$1,778,985 - $2,866,552**

The Direct Purchase option provides the greatest savings over the long-term, but does require initial project investment and ongoing Operations & Maintenance for the system. The PPA option, on the other hand, shows the lowest savings over the life of the systems, but, yearly payments with a rate schedule change could be lower than current or projected PG&E bills **starting in Year One**. With a PPA, no capital investment or balloon payments are necessary, and O&M is handled by the third-party system owner. Based upon projected values, Solar Leases for the recommended systems may be a valid option to consider for inclusion in an RFP issuance. Savings under a Lease or Loan option are typically lower than for a PPA for the life of the Lease or Loan, but after the buy-out (modeled at zero cost at Year 15), savings are significant. Based on this analysis, we recommend further investigation with private project developers through a competitive bid process to get the best results in terms of pricing and performance.

A financial analysis summary of all the individual sites is provided in Attachment A.

From an environmental perspective, the combined solar production will prevent the equivalent of nearly 170 metric tons of carbon dioxide from being released into the environment from current power sources annually. This amount of carbon sequestration can be visualized as planting approximately 140 acres of new forest. The carbon emissions reduction is

equivalent to eliminating approximately 390 thousand Vehicle Miles Traveled (VMT) annually. The total yearly energy production would be sufficient to power nearly 76 homes in the City of Sunnyvale.

Next Steps

If the City of Sunnyvale decides to pursue the recommended options, the following next steps have been identified to move this project along quickly and achieve the desired impact on cost reduction and green energy production before available solar incentives decrease. Also included is an estimate for duration of each step and when the work can be started.

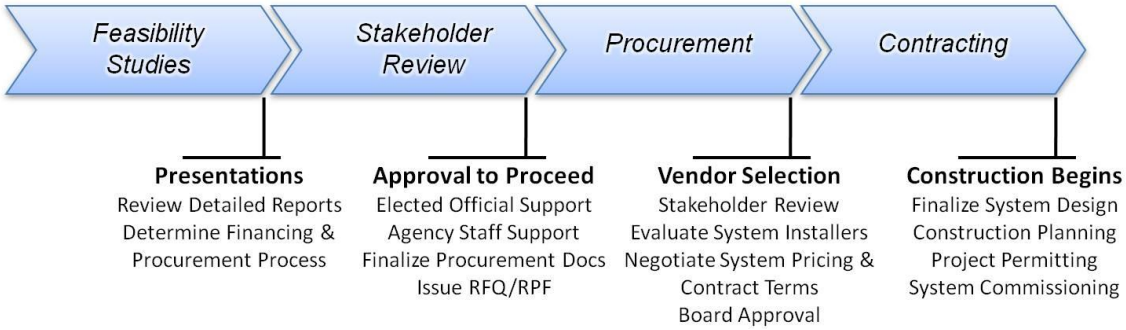
1) Build Consensus: Use the report's findings to build internal support, determine financing options, and appropriate procurement process. *Start: immediately, Duration: approximately 4-6 weeks*

2) Prepare Standard RFQ/RFP and Issue RFQ/RFP: After receiving approval to proceed, publish a procurement package and encourage vendor participation. *Start: upon approval of RFQ/RFP, Duration: approximately 14 weeks*

3) Evaluate Vendors, Proposals, Benefits and Costs in terms of design, price, performance, and capabilities, ensuring industry best practices are offered and contracted. *Start: upon receipt of proposals, Duration: approximately 4 weeks*

4) Select Vendor and Negotiate Contracts: Select vendor and review contract language to ensure maximum benefit for each agency. *Start: upon selection of shortlisted vendors, Duration: approximately 6 weeks*

5) Plan for Construction in 2014: Finalize financial arrangements, system design, and required building documents to begin installation and construction phase. *Start: upon project approval, Duration: approximately 6-8 weeks*



Methodology & Assumptions

Optony uses a rigorous methodology and client-focused approach to evaluate potential solar sites that goes well beyond the effort that is provided by system installers, finance companies, or even the utility companies. We combine our decades of experience in the solar field to balance the tradeoffs between technology, system design, rebates and incentive opportunities, electric demand and rate schedules, solar macro- and micro-economics, and available funding sources to develop an independent assessment of the realistic options at each site to meet the client's specific needs and goals.

Methodology and assumptions for this Feasibility Assessment:

- Optony uses a proprietary approach to performing a solar site analysis that uses dynamic scenario creation and evaluation processes along with publicly and privately developed software and tools to determine all the relevant variables and tradeoffs between options.
- For calculating available space at each site, the Optony team visited the site, took physical measurements, compared site available area with aerial views from Google Earth and performed shading analysis using Solmetric SunEye. Mapping software by Bing was also used for satellite imagery.
- Solar access is defined as the availability of direct sunlight which reaches the photovoltaic panels. A higher solar access percentage reflects fewer shading obstructions. Shading obstructions may include surrounding buildings, mechanical equipment on rooftops including antennas and power lines, architectural features of the building, tall trees, and other surrounding vegetation.
- Optony uses industry standard as well as proprietary financial modeling software with local utility rate schedules and typical meteorological year 3 data, and neutral to conservative inflation, SREC and Investment Tax Credit assumptions in all financial modeling. This approach allows Optony to present the client with realistic forecasting that reduces risks and estimates realistic project returns.
- Project timing is very important in the overall economics of a solar system installation due to the time-sensitive nature of the various federal, state, utility, and local incentives. Optony has evaluated the impact for construction completion in 2013.
- Optony has a unique insight into the latest solar technology due to its cooperative agreement and ongoing research with the National Renewable Energy Laboratory in Golden, CO. This has led to the achievement of world-record performance in thin film solar cells and major advancements in other emerging photovoltaic technologies.
- Optony does not sell equipment or installation services, and this report is not intended to provide a quote for future service; rather, it is a report on the ability of the pre-selected sites to produce power from the sun.

Disclaimer: This report is provided as an illustration of the potential benefits of a renewable energy system. The information presented in this report should not be construed as legal, tax or accounting advice. You should consult with professional advisors familiar with your particular factual situation for advice concerning specific matters before making any decision. Furthermore, this report may contain references to certain laws, regulations, tax incentives, rebates, programs and third party provided information. These will change over time and should be interpreted only in light of this particular engagement as of the date of this report.

About Optony Inc.

Optony Inc. is a global research and consulting services firm focused on enabling government and commercial organizations to bridge the gap between solar energy goals and real-world results. Optony's core services offer a systematic approach to planning, implementing, and managing commercial and utility-grade solar power systems, while simultaneously navigating the dramatic and rapid changes in the solar industry; from emerging technologies and system designs to government incentives and private/public financing options. Leveraging our independence, domain expertise and unique market position, our clients are empowered to make informed decisions that reduce risk, optimize operations, and deliver the greatest long-term return on their solar investments. Based in Silicon Valley, Optony has offices in Washington DC, Denver, Beijing and Hangzhou. Optony has participated in over 20 patent filings and continues to explore next-generation solar technologies and policies in collaboration with the National Renewable Energy Laboratory (NREL) and other leading research institutions.

For more information, visit www.optony.com

Attachment A-1: Solar PV Project Financial Analysis Summary (3% Utility Escalator)

	Corporation Yard	Hamilton Well / Water Plant	Mary-Carson Water Plant	Ortega Well	Raynor Well	San Lucar Pump Station	Serra Well	Wolfe-Evelyn Water Plant	Wright Avenue Water Plant	Sunken Garden - Lift Meter	Sunken Garden - Golf Range Meter	Baylands Park - Lift Meter	Baylands Park - Park Meter	Baylands Park - Storm Lift Meter	SMaRT Station	Landfill	Wastewater Treatment Plant Retention Ponds	Total for Utility Sites	Total Including Community Solar Sites
System Overview																			
System Size (kW)	25	-	-	122	-	-	-	-	-	-	-	28	38	-	241	5,000	5,000	**454**	**10,454**
Yield (kWh/kW)	1,507	-	-	1,410	-	-	-	-	-	-	-	1,451	1,451	-	1,441	1,576	1,607	**1,438**	**1,585**
Annual onsite energy usage (kWh) [1]	47,780	68,320	448,960	227,067	5,480	400,640	15,920	329,760	154,880	73,498	36,772	58,960	57,840	76,512	419,369	-	-	**2,421,758**	**2,421,758**
Year 1 Solar Output (kWh)	37,665	0	0	172,312	0	0	0	0	0	0	0	40,620	55,127	0	347,282	7,880,404	8,036,925	**653,005**	**16,570,335**
Annual PV degradation	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	**0.50%**	**0.50%**
Facility Energy Offset by Solar	79%	0%	0%	76%	0%	0%	0%	0%	0%	0%	0%	69%	95%	0%	83%	-	-	**81%**	**81%**
Current Utility Information																			
Utility Provider	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E		
Utility Rate Schedule	A-10 S TOU	A-1	A-6 TOU	A-6 TOU	A-6 TOU	A-6 TOU	A-1	A-6 TOU	A-6 TOU	A-1	A-1	A-1	A-1	A-6 TOU	E-19 SV	N/A	N/A		
Average Utility Cost ($/kWh)	$0.1315	$0.1883	$0.2324	$0.2324	$0.2324	$0.2324	$0.1883	$0.2324	$0.2324	$0.1883	$0.1883	$0.1883	$0.1883	$0.2324	$0.0966	-	-	**$0.2012**	**$0.2012**
Utility Annual Inflator (%)	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	**3.0%**	**3.0%**
Direct Purchase Information																			
Engineering, Procurement, and Construction $ [2]	$95,750	$0	$0	$489,000	$0	$0	$0	$0	$0	$0	$0	$80,080	$108,680	$0	$689,260	$19,150,000	$19,150,000	**$1,462,770**	**$39,762,770**
Solar Rebate ($/kWh)	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000		
Solar Rebate Term	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)		
Year 1 O&M	$375	$0	$0	$1,834	$0	$0	$0	$0	$0	$0	$0	$420	$570	$0	$3,615	$75,000	$75,000	**$6,814**	**$156,814**
Discount Rate	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	**3.00%**	**3.00%**
Lease/Loan Information																			
Lease/Loan Term	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)		
Lease/Loan Interest Rate (%)	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%		
End of Term Buyout	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		
PPA Information																			
Initial PPA rate ($/kWh) [2]	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500		
PPA annual escalator	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%		
S-REC Value (keep/sell) ($/kWh)	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000		
S-REC escalator	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
S-REC Contract Term	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)		
Buyer sells S-REC (Direct Purchase/Loan)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		
Environmental Impact																			
Annual CO2 Reduction (Tons)	10	-	-	45	-	-	-	-	-	-	-	11	14	-	91	2,055	2,096	**170**	**4,322**
Annual VMT Reduction Equivalent	22,543	-	-	103,130	-	-	-	-	-	-	-	24,311	32,994	-	207,851	4,716,478	4,810,157	**390,828**	**9,917,463**
Equivalent Annual Carbon Sequestration by US Forests (acres)	8	-	-	37	-	-	-	-	-	-	-	9	12	-	74	1,685	1,718	**140**	**3,543**
NPV of Total Energy COST																			
Utility Energy Purchase (25 year)	$228,251	$309,390	$1,681,714	$1,035,934	$31,070	$1,700,116	$77,203	$1,242,809	$580,904	$322,348	$166,169	$272,082	$269,525	$295,290	$2,501,756	$0	$0	**$5,091,354**	**$10,714,560**
PPA (25 year)	$135,402	-	-	$668,371	-	-	-	-	-	-	-	$159,810	$216,581	-	$1,348,398	$0	$0	**$2,528,562**	**$2,528,562**
Direct Purchase - incl O&M, rebate (25 year)	$107,441	-	-	$594,370	-	-	-	-	-	-	-	$106,865	$144,727	-	$900,949	$0	$0	**$1,854,352**	**$1,854,352**
Lease/Loan (25 year)	$114,785	-	-	$631,877	-	-	-	-	-	-	-	$113,008	$153,063	-	$953,816	$0	$0	**$1,966,549**	**$1,966,549**
% Energy Cost Savings (Undiscounted)																			
Direct Purchase (25 year)	66%	-	-	57%	-	-	-	-	-	-	-	69%	58%	-	72%	-	-		
Lease/Loan (25 year)	57%	-	-	47%	-	-	-	-	-	-	-	63%	49%	-	66%	-	-		
PPA (25 year)	41%	-	-	35%	-	-	-	-	-	-	-	41%	19%	-	46%	-	-		
Levelized Cost of Energy (LCOE) Analysis														-					
Utility LCOE ($/kWh) - (25 year)	0.2787	-	-	0.2661	-	-	-	-	-	-	-	0.2692	0.2718	-	0.3480	-	-	**0.3111**	-
Direct Purchase LCOE ($/kWh) - (25 year)	0.0952	-	-	0.1151	-	-	-	-	-	-	-	0.0826	0.1139	-	0.0973	-	-	**0.1024**	-
Lease/Loan LCOE ($/kWh) - (25 year)	0.1203	-	-	0.1421	-	-	-	-	-	-	-	0.0996	0.1375	-	0.1179	-	-	**0.1250**	-
PPA LCOE ($/kWh) - (25 year)	0.1649	-	-	0.1724	-	-	-	-	-	-	-	0.1588	0.2194	-	0.1884	-	-	**0.1836**	-

Note: The above analysis uses 3% utility escalation rate.

Attachment A-2: Solar PV Project Financial Analysis Summary (5% Utility Escalator)

	Corporation Yard	Hamilton Well / Water Plant	Mary-Carson Water Plant	Ortega Well	Raynor Well	San Lucar Pump Station	Serra Well	Wolfe-Evelyn Water Plant	Wright Avenue Water Plant	Sunken Garden - Lift Meter	Sunken Garden - Golf Range Meter	Baylands Park - Lift Meter	Baylands Park - Park Meter	Baylands Park - Storm Lift Meter	SMaRT Station	Landfill	Wastewater Treatment Plant Retention Ponds	Total for Utility Sites	Total Including Community Solar Sites
System Overview																			
System Size (kW)	25	-	-	122	-	-	-	-	-	-	-	28	38	-	241	5,000	5,000	**454**	**10,454**
Yield (kWh/kW)	1,507	-	-	1,410	-	-	-	-	-	-	-	1,451	1,451	-	1,441	1,576	1,607	**1,438**	**1,585**
Annual onsite energy usage (kWh) [1]	47,780	68,320	448,960	227,067	5,480	400,640	15,920	329,760	154,880	73,498	36,772	58,960	57,840	76,512	419,369	-	-	**2,421,758**	**2,421,758**
Year 1 Solar Output (kWh)	37,665	0	0	172,312	0	0	0	0	0	0	0	40,620	55,127	0	347,282	7,880,404	8,036,925	**653,005**	**16,570,335**
Annual PV degradation	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	**0.50%**	**0.50%**
Facility Energy Offset by Solar	79%	0%	0%	76%	0%	0%	0%	0%	0%	0%	0%	69%	95%	0%	83%	-	-	**81%**	**81%**
Current Utility Information																			
Utility Provider	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E	PG&E		
Utility Rate Schedule	A-10 S TOU	A-1	A-6 TOU	A-6 TOU	A-6 TOU	A-6 TOU	A-1	A-6 TOU	A-6 TOU	A-1	A-1	A-1	A-1	A-6 TOU	E-19 SV	N/A	N/A		
Average Utility Cost ($/kWh)	$0.1315	$0.1883	$0.2324	$0.2324	$0.2324	$0.2324	$0.1883	$0.2324	$0.2324	$0.1883	$0.1883	$0.1883	$0.1883	$0.2324	$0.0966	-	-	**$0.2012**	**$0.2012**
Utility Annual Inflator (%)	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	**5.0%**	**5.0%**
Direct Purchase Information																			
Engineering, Procurement, and Construction $ [2]	$95,750	$0	$0	$489,000	$0	$0	$0	$0	$0	$0	$0	$80,080	$108,680	$0	$689,260	$19,150,000	$19,150,000	**$1,462,770**	**$39,762,770**
Solar Rebate ($/kWh)	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000		
Solar Rebate Term	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)		
Year 1 O&M	$375	$0	$0	$1,834	$0	$0	$0	$0	$0	$0	$0	$420	$570	$0	$3,615	$75,000	$75,000	**$6,814**	**$156,814**
Discount Rate	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	**3.00%**	**3.00%**
Lease/Loan Information																			
Lease/Loan Term	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)	15 year(s)		
Lease/Loan Interest Rate (%)	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%		
End of Term Buyout	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		
PPA Information																			
Initial PPA rate ($/kWh) [3]	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500	$0.1500		
PPA annual escalator	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%		
S-REC Value (keep/sell) ($/kWh)	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000		
S-REC escalator	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
S-REC Contract Term	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)	year(s)		
Buyer sells S-REC (Direct Purchase/Loan)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		
Environmental Impact																			
Annual CO2 Reduction (Tons)	10	-	-	45	-	-	-	-	-	-	-	11	14	-	91	2,055	2,096	**170**	**4,322**
Annual VMT Reduction Equivalent	22,543	-	-	103,130	-	-	-	-	-	-	-	24,311	32,994	-	207,851	4,716,478	4,810,157	**390,828**	**9,917,463**
Equivalent Annual Carbon Sequestration by US Forests (acres)	8	-	-	37	-	-	-	-	-	-	-	9	12	-	74	1,685	1,718	**140**	**3,543**
NPV of Total Energy COST																			
Utility Energy Purchase (25 year)	$290,273	$393,459	$2,138,677	$1,317,422	$39,512	$2,162,079	$98,180	$1,580,511	$738,749	$409,938	$211,321	$346,013	$342,762	$375,527	$3,181,544	$0	$0	**$6,474,800**	**$13,625,968**
PPA (25 year)	$136,557	-	-	$690,735	-	-	-	-	-	-	-	$165,704	$224,496	-	$1,393,969	$0	$0	**$2,611,461**	**$2,611,461**
Direct Purchase - incl O&M, rebate (25 year)	$108,596	-	-	$616,734	-	-	-	-	-	-	-	$112,759	$152,642	-	$946,520	$0	$0	**$1,937,251**	**$1,937,251**
Lease/Loan (25 year)	$115,940	-	-	$654,241	-	-	-	-	-	-	-	$118,901	$160,978	-	$999,387	$0	$0	**$2,049,447**	**$2,049,447**
% Energy Cost Savings (Undiscounted)																			
Direct Purchase (25 year)	73%	-	-	65%	-	-	-	-	-	-	-	75%	65%	-	77%	-	-		
Lease/Loan (25 year)	67%	-	-	57%	-	-	-	-	-	-	-	70%	59%	-	72%	-	-		
PPA (25 year)	54%	-	-	49%	-	-	-	-	-	-	-	53%	36%	-	57%	-	-		
Levelized Cost of Energy (LCOE) Analysis														-					
Utility LCOE ($/kWh) - (25 year)	0.3648	-	-	0.3484	-	-	-	-	-	-	-	0.3524	0.3558	-	0.4555	-	-	**0.4072**	-
Direct Purchase LCOE ($/kWh) - (25 year)	0.0970	-	-	0.1220	-	-	-	-	-	-	-	0.0895	0.1234	-	0.1049	-	-	**0.1096**	-
Lease/Loan LCOE ($/kWh) - (25 year)	0.1222	-	-	0.1490	-	-	-	-	-	-	-	0.1066	0.1470	-	0.1255	-	-	**0.1321**	-
PPA LCOE ($/kWh) - (25 year)	0.1667	-	-	0.1793	-	-	-	-	-	-	-	0.1657	0.2289	-	0.1960	-	-	**0.1908**	-

Note: The above analysis uses 5% utility escalation rate